ANNUAL REPORT OF THE ASSISTANT DIRECTOR 1956-1957

JULY, 1957
NO. 28

Joint Highway Research Project

PURDUE UNIVERSITY
LAFAYETTE INDIANA

by

H.L. MICHAEL

ANNUAL REPORT OF ASSISTANT DIRECTOR, 1956-1957

TO: Professor K. B. Woods, Director
Joint Highway Research Project

July 24, 1957
File: 10-2-3

FROM: Harold L. Michael, Assistant Director

Attached is the 19th in a series of annual reports which have been submitted since 1938 covering the activities of the Joint Highway Research Project. This report covers the period July 1, 1956 to June 30, 1957.

Included is a brief description of all the research projects which were active the past year as well as a listing of the reports made to the Board at the nine meetings held. Attendance at Advisory Board Meetings is also enumerated and complete lists of Project staff and extra labor employees are included. New staff members, changes in rank of staff, and resignations are also presented.

The publications of the Project and its staff and their professional activities during the year are discussed. Ten Engineering Reprints covering research performed in the Project were released during the year thus bringing this publication series to No. 126. A listing of theses and papers published during the year is also included.

Some of the outstanding accomplishments during the year have been completion of the county drainage mapping program and initiation of the preparation of a drainage map atlas; development of the use of the Kelsh Plotter; completion of research projects by ten degree candidates; important research in the areas of bituminous mixes, rigid pavement pumping, subsurface exploration, accident correlation with road features, and selection and retention of Civil Engineer employees; continuation of the Highway Needs Study; completion of the pavement deflection project in cooperation with the Bureau of Public Roads; and the initiation of research in the hydraulics area. These and other research projects and the many staff members associated with them contributed to the success of the year's activities.

Respectfully submitted,

Harold L. Michael

Harold L. Michael, Assistant Director
Joint Highway Research Project

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F. H. Green
M. J. Gutzwiler
M. E. Harr
C. W. Lovell, Jr.
J. F. McLaughlin
R. D. Miles
W. W. Mylroie
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L. E. Wood
P. T. Yeh
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1956-1957

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Assistant Director

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Purdue University
Lafayette, Indiana

July 24, 1957

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ANNUAL REPORT OF THE ASSISTANT DIRECTOR

RESEARCHES OF THE JOINT HIGHWAY RESEARCH PROJECT

The Joint Highway Research Project in the School of Civil Engineering is organized to do cooperative research with the State Highway Department of Indiana. Research was initiated on June 1, 1936, and formally authorized by an act of the Indiana State Legislature on March 11, 1937, and amended March, 1949. The purpose of this organization is to make basic studies of materials used in highways; to facilitate economical design, construction, and maintenance of county and state highways; to investigate traffic, safety, and economics; to provide advanced instruction in the fundamentals of highway engineering and related research; and to provide practical experience in construction and maintenance procedures and use of highway materials. The Project is guided by an Advisory Board consisting of five members of the State Highway Department and six members of the staff of the School of Civil Engineering at Purdue University.

Sponsored research in the field of highway engineering is also conducted by this organization and several such projects were active during the past year.

The research conducted during the year in the eight laboratories of the Project for the State Highway Department was varied and important. A total of 46 different research studies were in progress with 11 of these completed and 12 initiated. Fifty-eight formal reports were presented to the Advisory Board during the year of which 31 were detailed reports of research

conducted and twelve were working plans for new or continued research. The Board received and accepted 2581 pages of information during the year. Titles of the various reports, together with other pertinent information, is given in another section of this report.

A broad program of research in the area of materials engineering continued during the year. The studies included outstanding work on subgrades and pumping, use of aerial photographs in engineering soils studies and terrain evaluation, a comparison of various methods of subsurface exploration, and several projects that provided information that will be helpful in the design of bituminous concrete pavements. An important project concerned with the skid characteristics of bituminous surfaces was initiated during the year.

In the field of portland cement concrete, the emphasis has been placed on research dealing with basic properties of concrete materials and has included a study of aggregate porosity and permeability as related to concrete durability.

Activity in the bituminous area has been concerned, for the most part, with the evaluation of bituminous mixture performance in service and the testing of these mixtures in the laboratory for strength characteristics. The studies have included strength and deformation characteristics of bituminous mixtures under various conditions of loading and temperature. Repeated load tests and tests under high confining pressure are especially significant to these studies.

Some of the signigicant projects active during the year in the area of transportation engineering included a Needs Study of Indiana Highways, a personnel study aimed at methods of selecting and retaining Civil Engineer Employees, several operational studies of highway facilities, a study of the

use of the Kelsh Plotter in improving highway productivity, and the completion of the county drainage mapping program. This latter project has been active since 1946. Maps containing the various drainage features of each county in Indiana are now available and are being used extensively by those concerned with highway construction.

The Highway Needs Study neared completion during the year and data from it contributed greatly to the discussion of highway inadequacy during the meeting of the 1957 Legislature. In this study, the physical as well as an estimate of the financial needs are enumerated and a 15-year improvement program that would develop all of our highways to adequacy is presented.

Continuing programs of the skid characteristics of pavement surfaces, speed trends, and truck weight trends also were active. In cooperation with the Bureau of Public Roads, a study of the subgrade support characteristics of nine different subgrade treatments was made and instrumentation for the measurement of pavement deflections was developed.

In the field of traffic safety a study of the correlation of accidents and roadway factors produced valuable information, while studies of the use of 4-way stop signs and lane-use markings contributed to a better utilization of these traffic engineering tools.

During the year the Roughometer and skid equipment that had been developed by the Project were turned over to the State Highway Department to use in continuing programs of highway evaluation. The two vehicles that were associated with these pieces of equipment were likewise released to the State.

Research was expanded into a new area for the Project when two projects were approved in the hydraulics area under Professor Delleur.

Outstanding among honors and recognition that were received during the year by various staff members were the selection of the Director of the

Project, K. B. Woods, as Chairman of the Advisory Committee for the AASHO Road Test at Ottawa, Illinois and as First Vice President of ASTM. He also served as Chairman of the Highway Research Board during 1956. Professor Goetz was elected first Vice President of AAPT and Professor Petty was honored as "Engineer of the Year" by the Indiana Society of Professional Engineers. Professor Berry was selected as Chairman of the Traffic and Operations Department of the HRB. Professor Goetz and Mr. Andersland also received an award for presenting the best paper at the 1956 meeting of the AAPT. The paper was entitled "Sonic Test for Evaluation of Stripping Resistance in Compacted Bituminous Mixtures".

Highway and traffic extension activities also increased during the year. A very successful Road School was held April 22-25, 1957 under the direction of Professor Petty. Advice and counsel were given to several cities and counties and traffic or road classification studies were performed at Crown Point, Indiana, and for Dubois and Jay counties.

A short discussion of each of the active project during the past year follows:

Airphoto Interpretation Research

Topographic Mapping from Airphotos (C-36-32L)

Investigator: W. G. Prescott under the direction of R. D. Miles.

A study of the use of a Kelsh Plotter and photogrammetric techniques in the preparation of large scale topographic maps of individual bridge sites and of proposed highway locations. Maps have been made of several bridge sites at a scale of 1 inch equals 30 feet and 4 miles of road plans have been mapped at a scale of 1 inch equals 50 feet. The program is continuing.

Mapping for Preliminary Location (C-36-32M)

Investigator: D. A. Bailey under the direction of R. D. Miles.

This project will involve selections of several alternate routes for Highway U. S. 150 from New Albany west across the Knobstone Escarpment, for about 8 miles. The investigations will involve using aerial photo coverage along with any topographic maps available. After one or two routes have been selected as most feasible a photogrammetric map will be made to provide contours at 5 feet intervals, and scale of 200 feet per inch and on which map a proposed highway route will be laid out to interstate highway standards. The photogrammetric map will be made with a Kelsh Plotter.

Use of Airphotos to Predict Subsurface Conditions (C-36-36F)

Investigator: B. H. Moore under direction of R. D. Miles.

A project to determine the extent to which airphotos can be used in obtaining information about subsurface conditions in foundation studies. Airphoto interpretations were correlated with field observations and data obtained in connection with the Indiana Toll Road. The study was completed August 1956. It was concluded that a general description of parent materials can be obtained from airphotos for foundation studies, but that actual depths of soil layers, organic or inorganic, are only inferred approximations.

County Drainage Maps from Airphotos (C-36-51A)

Investigator: Merle Parvis under the direction of R. D. Miles.

Very detailed drainage maps at a scale of one inch equals one mile are prepared from stereoscopic study of aerial photographs. Maps have been made for all 92 counties in the State of Indiana. At the present time an atlas of all the counties is under preparation.

Indiana Engineering Soils Mapping Program (C-36-51B)

Investigator: P. T. Yeh under the direction of R. D. Miles.

The object of this project is twofold: First, to investigate and to develop the airphoto patterns of different types of engineering soils in Indiana; second, to obtain a complete engineering soils map for the State. Soils of different engineering characteristics are mapped exclusively from airphotos on a regional basis or on a county basis. Only very limited field investigations are conducted to secure representative soil samples and to check the interpretations. About one-half of the State has been mapped in this study.

Granular Material Study Using Airphotos (C-36-51H)

Investigator: R. D. Leighty under the direction of R. D. Miles.

The purpose of the study was to develop a procedure for the evaluation of fluvio-glacial terraces from aerial photographs. The study also included the investigation of the extent to which airphotos can be used in establishing physical characteristics of alluvial gravels. The study was completed in August 1956. The major conclusions reached are that the aerial photographs are extremely valuable in determining location and general characteristics of possible borrow areas, and that detailed ground investigation is necessary to determine physical characteristics and engineering properties of the material in the borrow area.

State Drainage Map (C-36-51J)

Investigator: P. T. Yeh under direction of R. D. Miles.

A project undertaken to prepare a State drainage map at a scale of 1/4 inch equals one mile utilizing individual detailed county drainage maps previously prepared. Fifty counties have been plotted to date.

Bituminous Materials and Flexible Pavement Research

Bituminous Resurfacing Mixtures (C-36-6F)

Investigator: J. F. McLaughlin under the direction of W. H. Goetz.

A laboratory study was completed on the testing of resurfacing mixture samples in the field and molded in order to investigate load-carrying characteristics. A rapid-cycle repeated-load test was developed to study the effect of number of load repetitions on the cumulative permanent deformation of the specimen. The test was demonstrated to be a promising method for the evaluation of the plastic character and endurance properties of bituminous aggregate mixtures.

Strength and Deformation Characteristics of Bituminous Mixtures (C-36-6J)

Investigator: L. E. Wood under the direction of W. H. Goetz

The strength and deformation characteristics of various bituminous mixtures were studied at several temperatures by means of confined and unconfined compression tests using different rates of deformation. Included in this study were the effects of static and repeated loads upon mixture properties. The study is continuing to evaluate the effect of variables such as asphalt content density and grade of asphalt cement upon the ability of a bituminous mixture to withstand repeated loads.

Triaxial Testing of Bituminous Mixtures at High Confining Pressures (C-36-6K)

Investigator: J. C. Oppenlander under the direction of W. H. Goetz.

This laboratory study investigated the triaxial testing of bituminous mixtures at high confining pressures. The object of this research was to develop a better understanding of the basic factors that contribute to the development of shearing strength in bituminous-aggregate mixtures.

The variables considered in this investigation were aggregate gradation, confining pressure, specimen height, degree of compaction, type of aggregate, and asphalt content

Bituminous Concrete Resurfacing (C-36-31C)

Investigator: W. H. Goetz.

Further performance surveys and samplings were made of bituminous concrete resurfacing. Data were obtained on the increase in density under traffic and on the density at construction as compared to that reached after several years of service. It was shown that increased density in construction is desirable and necessary for realistic design.

Skid Characteristics of Bituminous Mixtures (C-36-53D)

Investigator: J. Shupe under the direction of W. H. Goetz.

A laboratory study of the skid characteristics of bituminous mixtures is being undertaken in an attempt to study the effect of variables under controlled conditions. Equipment has been built, but no test results are yet available.

Cores from U. S. 31 Test Road (C-36-55F)

Investigators: W. Sutton and M. Stewart under the direction of W.H. Goetz.

Cores were taken from the U. S. 31 flexible pavement test road and measured for thickness of base, binder and surface layers; density measurements were made on these components, also. These height and density data were analyzed. It was shown that core thickness varies from 3.24 to 6.00 inches and that all layers have become more dense under traffic. Most of the increase occurred in the first 20 - 22 months of traffic.

Chemistry of Materials Research

Dampproofing Treatment of Bridges (C-36-37Z)

Investigators: The Staff under the direction of W. L. Dolch

In the fall of 1956 parts of two new overpass highway bridges near Marion, Indiana were treated with a silicone solution through the courtesy of the manufacturer of the product. This bridge will be observed to determine if important improvement in durability is obtained by the treatment with respect to the non-treated portion.

Porosity Characteristics of Aggregates (C-36-47F)

Investigator: W. L. Dolch

This project is concerned with the description of the pore structure and associated properties of concrete coarse aggregates. These properties are important to the durability of concrete, particularly in freezing and thawing exposure. The approach used so far has involved the relationships between pore structure and the flow of fluids through these materials, density, porosity, permeability, absorptivity, tortuosity, and water vapor absorption have been measured. The properties of a model have been calculated from these data. Tentative relationships between field performance and certain of these properties have been found. Studies to date have been on limestones. Work is proceeding along these lines.

Test Methods Related to the Alkali-Aggregate Reaction (C-36-47G)

Investigator: W. L. Dolch

Certain aspects of the "quick-chemical test" for reactive aggregates are being studied. Standard powdered pyrex glass is being used as the test material. Efforts are being made chiefly in the direction of improving the reproducibility of the test method. Some aspects of the chemical analysis of the alkalis in portland cement are also being studied.

Concrete Materials and Rigid Pavement Research

Determination of Air Content of Hardened Concrete (C-36-37Q)

Investigator: F. K. Fears under the direction of J. F. McLaughlin

Measurement was made of the air content, number of voids per inch, and bubble spacing factors of hardened concrete by the linear traverse method. The effects of these factors on the laboratory and field durability of concretes were investigated. This project is now complete and the publication of the results has been in a thesis, Purdue Ph.D, February 1957, by Mr. Fears.

Durability and Deterioration of Structural Concrete (C-36-37R)

Investigator: J. F. McLaughlin

A field study of structures to determine the scope of the problem of concrete deterioration and the probable causes forms the basis of this study. The present phase is concentrated on new structures in which air-entrained concrete was used.

H R B Cooperative Study of Concrete Freezing and Thawing (C-36-37U)

Investigator: J. F. McLaughlin

Participation in a cooperative investigation of freezing and thawing tests on concrete, set up by Highway Research Board Committee B-1, "Durability of Concrete, Physical Aspects," was the basis of this study. Purpose of the study is to determine the characteristics and variability of freezing and thawing methods and equipment.

The laboratory portion of the study is now complete and the preparation of a final report by all laboratories is in progress.

Field Survey of Air-Entrained Concrete Pavements (C-36-37W)

Investigator: J. F. McLaughlin

This project is a condition survey of concrete pavement built since the introduction of air-entrained concrete for Indiana roads. The survey is being conducted as the field phase of the evaluation of aggregate durability to obtain information helpful in setting up specification tests based on freezing and thawing of concrete.

Evaluation of Aggregate Durability by Freezing and Thawing Tests of Concrete (C-36-37X)

Investigator: J. F. McLaughlin

This is a project consisting of the testing of aggregates in concrete subjected to freezing and thawing in automatic equipment. Aggregates from

many sources are to be tested to obtain information helpful in setting up better specifications for concrete aggregates.

The investigation also includes various studies of factors affecting concrete durability, such as maximum aggregate size and water/cement ratio. Studies of variations in test method for freezing and thawing tests, such as the use of aluminum foil for wrapping beams, etc., are included.

Characteristics of Aggregates from Indiana Sources (C-36-42E)

Investigator: R. L. Schuster under the direction of J. F. McLaughlin

The nature of the deleterious constituents in Indiana gravels and crushed stones is being investigated in order to determine the quantitative effect of the various materials on the quality of concrete. Better identification methods are also being sought.

The Effect of Temperature on the Air Bubble Distribution in Concrete (C-36-61A)

Investigator: J. F. McLaughlin

This project is being initiated to study temperature effects on strength and durability of concrete with particular reference to how temperatures of the plastic concrete may change bubble characteristics and hence influence other properties at a later time.

Economics, Administration and Finance Research

State Highway Needs Study (C-36-54T)

Investigator: Donald O. Covault, H. L. Michael and A. K. Branham under the direction of H. L. Michael

During the past two years an engineering appraisal of the needs of the State, County and City Systems in Indiana, has been performed. Present and future deficiencies that will occur or have occurred on these systems have been determined. Based on 1955 prices of construction and maintenance, nearly $336 million a year must be spent for the next 15 years to rebuild the highway

system to tolerable or design standards. Other needs of a non-fiscal nature were studied, among these needs are highway safety, classification of roads and streets, traffic engineering and the supply of engineers and technicians.

Selection and Retention of Civil Engineers (C-36-54X)

Investigator: A. K. Branham

One of the most serious problems to be solved is the critical shortage of civil engineers, architects, technicians, craftsmen, and others engaged in the construction industry. The available data show that the number of engineers and technicians graduated in recent years is inadequate. Furthermore, the population and enrollment trends indicate the shortage will remain for the next decade. This project is a study of that problem.

In supplying and maintaining technical personnel, management must use the most effective personnel techniques known to industry, if it expects to meet the challenge. The selection, employment, training, and maintenance of personnel are important phases of technical administration. Job or position classification, employee recruitment, selection and placement, continuity of service, wage and salary schedules, training, promotion and transfers, working hours, holidays, annual leave or vacation, and other techniques are fundamental concepts of good administrative practices. These concepts were investigated.

The study shows that salaries in public agencies must be increased if they are to compete favorably with private industry. Furthermore, a salary schedule for the various grades of engineers is developed.

Economic Impact of Proposed Shopping Centers Upon the Lafayette Metropolitan Area (C-36-54X)

Investigator: Mart Kask under the direction of H. L. Michael

A shopping center does not have a slow evolutionary growth but, instead,

emerges full blown on opening day, its problems cannot be solved by periodic traffic counts from which future growth and highway needs can be projected. A delayed improvement program makes necessary land acquisition doubly difficult and expensive, temporarily increases the congestion and seriously hampers the center's operation. An extended limitation on the center's operation can have the effect of a reduced evaluation with a subsequent reduction in tax returns. If a realistic program of road improvement can be evolved and put into effect during the planning stage of the shopping center so that the sudden revision in the existing traffic pattern is balanced with the facilities provided, the shopping center can then assume its important role in the community. These are the aspects treated in this study that will be completed in July 1957.

Receipts and Disbursements for Highways in North Central States (C-36-60B)

Investigator: Willa Mylroie

A prospectus has been prepared covering receipts for highway purposes from each source, and amount by source from specified vehicle groups. Disbursements of receipts from 1920-1956 by governmental units for various purposes are also considered. The information will be obtained and analyzed for each of the North Central States if available.

Soils and Pavement Design Research

Effect of Rate of Loading (C-36-14B)

Investigator; D. Hampton directed by E. J. Yoder

A laboratory study to determine the effect of rate loading on ultimate compression strength and modulus of deformation of soil under various moisture and density conditions. Rates of loading are varied from 0.001 inches per minute to transient (duration of test 0.005 sec.) This study is just being initiated.

Methods of Subsurface Exploration (C-36-36E)

Investigator: D. G. Shurig under the direction of E. J. Yoder

This study pertains to the use of power augers and electrical resistivity units to supplement diamond core drilling machines for highway subsurface exploration. Basis of the study was the data taken during the original subsurface exploration program conducted on the Northeastern Extension of the Pennsylvania Turnpike System.

The operation of, capabilities of, and especially the accuracy of locating the "top of sound rock" with each machine, were determined for various types of subsurface conditions in cut areas. An analysis of costs of using drilling machines, power augers and electrical resistivity for highway exploratory work was also presented.

Performance of Rigid Pavements on Base Courses (C-36-45F)

Investigator: E. J. Yoder

A study was made of airfield and highway rigid pavements constructed on base courses. Purpose of this investigation was to determine the gradation requirements for base courses for control of pumping.

Flexible Pavement Design (C-36-52B)

Investigator: E. J. Yoder

A field study of the performance of flexible pavements. The study is aimed at determining design procedures applicable to Indiana. It is just being initiated.

Structural Research

Stress and Deflection in Plain and Reinforced Concrete (C-36-46M)

Investigator: Melton Miller under the direction of J. L. Waling and M. J. Gutzwiller

This project will give a summary of the existing knowledge regarding stresses and deflections in plain and reinforced concrete pavements. It will

also be an attempt to evaluate the existing theories concerning stresses and deflections in plain and reinforced concrete pavements by studying their assumptions and limitations. An attempt will be made to determine analytically the stresses and deflections in continuously reinforced concrete pavements and verify some of the measured results from the specimens being tested in the laboratory.

Creep and Shrinkage Strains in Prestressed Concrete (C-36-58A)

Investigator: E. J. Midgaard under the direction of J. L. Waling and M. J. Gutzwiller

This investigation concerned creep in prestressed concrete with the aggregate as the varying factor. The two aggregates used were limestone from the Ohio and Indiana Stone Company, Greencastle, Indiana, and glacial gravel from Western Indiana Sand and Gravel Company, West Lafayette, Indiana. Four different stress levels were used in the concrete. The creep was measured on unloaded beams. Special shrinkage specimens were cast to differentiate between creep and shrinkage. Gage points were embedded in the faces of the beams from which the necessary measurements were made.

The prestress tension used were 3/8" and 1/2". The results showed that a concrete having the gravel as aggregate gave less creep than the concrete with the limestone aggregate. Neither of the aggregates will produce concrete that will cause excessive prestress loss due to shrinkage and creep.

Fatigue Properties of Air-Entrained Concrete (C-36-58B)

Investigator: J. D. Antrim under the direction of J. F. McLaughlin and M. J. Gutzwiller

This project is concerned with establishing whether or not there is a definite distinction between the resistance to fatigue of air-entrained plain

concrete and non-air-entrained plain concrete. The specimens being used are 3-inch diameter by 6-inch high concrete cylinders which are tested in compression at specific stress levels in the Krouse-Purdue Axial-load Fatigue Testing Machine whose operating speed is 1000 cycles per minute. A sufficient number of specimens will be tested to insure statistically sound results. Two mix designs, one for the non-air-entrained concrete and one for the air-entrained concrete (7% air content), of similar strengths are being used. Upon the completion of this project it is expected that related phases will be investigated.

Traffic Engineering and Safety Research

Periodic Speed Studies (C-36-10C)

Investigator: K. A. MacNaughton under the direction of H. L. Michael.

Since 1941, periodic traffic speed studies have been carried out by the Joint Highway Research Project. Speeds are taken at the same stations each time in order to be able to compare the studies.

In the latest study an increase of approximately two miles per hour was noted for passenger cars while truck speeds decreased approximately one-half mile per hour since August 1956.

Truck Speed-Weight Studies (C-36-10D)

Investigator: R. J. Henning under the direction of H. L. Michael

Annually in August in cooperation with the Highway Planning Survey Unit of the State Highway Department of Indiana speed and weights of trucks are obtained. A correlation is made and the trend of speed and weights is analyzed. Indiana is one of many states conducting such a study under the national direction of the Bureau of Public Roads.

Intersection Lane Controls (C-36-17K)

Investigator: K. A. MacNaughton under the direction of D. S. Berry.

In order to alleviate congestion at intersections and reduce sideswipe accidents at intersection exits, some communities have adapted a plan in which straight-through vehicle movements are restricted to one lane of a two lane approach while the other lane is used exclusively by one of the turning movements. This practice is followed in Lafayette.

This project is being carried out to determine what conditions are best for the installation of this control. Adding machines are used as recorders and a great amount of vehicle movement data can be recorded in a short time.

Supplementary Legend at Four-Way Stop Intersections (C-36-17Q)

Investigator: B. K. Cooper under the direction of D. S. Berry.

The purpose of this study is to determine if the efficiency of existing four-way stop intersections can be improved by adding the supplementary legend "4-way."

A before and after study will be made of both local and out-of-state motorists. A stop watch will be used to measure accepted or rejected lags. An observance study will also be conducted to determine if the addition of the legend "4-way" decreases driver observance.

Preliminary analysis of data indicates that the critical lag of the intersections studied has decreased, thus increasing capacity, while no significant change is evident in driver observance.

Effect of Edge Marking on Lateral Placement (C-36-17R)

Investigator: P. M. Weckesser under the direction of H. L. Michael.

This project will be concerned with the investigation of the speed and lateral placement of vehicles on two lane bituminous highways with widths of 20', 22', and 24', both before and after the placement of pavement edge lines.

Test locations for this project will be selected on highways near the Lafayette area. Representative samples of vehicles will be observed at these test locations during the day and at night both before and after the placement of the edge lines. The speed and lateral placement data will be collected by placing a segmented electrical detector and a pneumatic tube across the highway. The electrical pulses received when a vehicle crosses these two elements will be recorded automatically on a 20-Pen Graphic Recorder.

After a complete analysis of the data collected, the effect, if any, of pavement edge lines on the speed and lateral placement of vehicles on two lane bituminous highways will be determined.

Correlation of Accident Rates and Roadway Factors (C-36-59C)

Investigator: John C. H. Woo under the direction of H. L. Michael.

The primary purpose of this study was to investigate the correlation between motor vehicle accidents and roadway factors in Indiana. The factual analysis of the relevant roadway factors - average daily traffic volume, capacity, congestion index, number of lanes, lane width, shoulder width, horizontal alignment, and number of entrances with the accident rate was performed.

A total of 3,136 miles of rural primary system was divided into 987 subsections on the basis of the homogeneity in the above roadway factors, utilizing the 1954 and 1955 road inventory data. The number of accidents for each subsection was obtained from accident spot maps of the Indiana State Police. The results of analysis reveals that there are definite relationships between average daily traffic volume, congestion, lane width, and number of entrances per mile with the number of accidents per roadway mile.

Special Research Projects

Skid Resistance of U. S. 31, Test Road (C-36-53E)

Investigator: John Shupe under the direction of H. L. Michael.

In conjunction with the State Highway Department a long-term study of the skid characteristics of a Portland cement-concrete pavement and an adjoining bituminous-concrete pavement is in progress. Skid tests are performed semi-annually, winter and summer, and the changes in skidding characteristics are evaluated.

As of January, 1957 the skid equipment was delivered to the SHDI and they accepted the responsibility of this project.

Lateral Placement on U. S. 31 Test Road (C-36-53F)

Investigator: P. M. Weckesser under the direction of H. L. Michael.

This project will be concerned with the investigation of the lateral placement of vehicles on abutting sections of portland cement concrete and bituminous concrete pavement on the U. S. 31 Test Road north of Columbus, Indiana.

Eight test locations on portions of the test road will be selected for the project. These test locations will be on level, tangent sections of the highway having similar roadside culture. Representative samples of vehicles will be observed at each of these locations both during the day and at night under normal driving conditions. The lateral placement of the vehicles will be determined by placing a segmented electrical detector across the highway. The electrical pulse received when a vehicle crosses the element will actuate the appropriate recording pen denoting the distance from the edge of the highway that the vehicle was traveling.

Skid Characteristics of Silica Sand Pavement Surface (C-36-53H)

Investigator: John Shupe under the direction of H. L. Michael.

An experimental silica-sand surface was placed on a state highway in southern Indiana in recent years and this project was established to study its skid characteristics. Once each year skid tests at various speeds are conducted on this surface and on an adjoining bituminous-concrete surface. The skid characteristics as well as their trend is then evaluated.

This project is as of January 1957 the responsibility of SHDI.

Runoff from Small Drainage Areas (C-36-62A)

Investigator: J. W. Delleur

The purpose of this new project is to study the hydrology of watersheds of less than 50 square miles throughout Indiana and to improve the existing methods for estimating runoff from these watersheds. A study and analysis of existing records as well as a pilot installation of field equipment to measure runoff are contemplated.

Hydraulics of Arch Bridges (C-36-62B)

Investigator: J. W. Delleur.

This new project is being initiated to study the effect of Arch bridges on stream flow during periods of high stream flow and to analyze the various factors involved. Information useful in the design of Arch bridges is contemplated.

Relative Support Characteristics of Nine Subgrade Treatments (C-36-A)

Investigators: R. L. Anderson, J. W. Dunkin, M. E. Harr, L. E. Wood, R. C. Geldmacher, and G. Partridge under the direction of R. C. Geldmacher.

A means was developed for measuring the relative deflection between a point in a concrete highway slab and a point in the earth beneath.

All records were made using a 14-channel system designed and developed as part of the project. The complete system could be used to record 14 simultaneous events.

Experiments were conducted which provided information about the linearity of the pavement-earth system, the effect of changes in vehicle position and speed, the effect of changes in environment, the motion beneath a loaded pavement, strains in the slab and the relative support characteristics of nine subgrade treatments. In addition a theoretical analysis and statistical study were made. The project was completed in February 1957 and a final report presented.

TRAFFIC ENGINEERING SERVICES

In 1954, a unit known as Traffic Engineering Services Unit was organized within the Joint Highway Research Project at Purdue University to provide traffic and transportation engineering services for the city and county governmental units of Indiana. The services offered are primarily of advice and counsel on traffic and highway problems on an extension basis. Arrangements may also be made, however, for this Unit to supervise and assist in the conduct and analysis of traffic and highway studies with the cost borne by the governmental unit concerned. The activity of the Unit during the past year has been as follows.

Item No.	Governmental Unit	Services Rendered	Status
1	West Lafayette	Advice and counsel on the traffic problems and parking needs of the city. Numerous meetings held with Citizens Committee and city officials.	Active
2	Crown Point	Advice and counsel on a thoroughfare plan and a parking plan for the city. Supervision of a parking and volume count study of the city was provided. Analysis of studies now are under way. A preliminary report has been made to city.	Active
3	Dubois	A county road classification study is in progress under the direction of the county engineer. An inventory and needs of the county primary and secondary system will be made. Advice, counsel, analysis of data, and preparation of report are provided by Purdue. A preliminary report to the county has been made.	Active
4	Crawfordsville	Advice and counsel to city officials for conduct of studies recommended for city in its position as a pilot city of the National Committee on Urban Transportation. Studies of traffic and street services are in progress and research on these studies in addition to assistance to Crawfordsville is being made.	Active

Item No.	Governmental Unit	Services Rendered	Status
5	Seymour	Correspondence with city officials concerning advice on traffic problems resulted in one meeting of the city officials at which traffic advice was given.	Inactive
6	Marion	Discussions on traffic problems in city initiated in late June and continued into July 1956.	Inactive
7	Hobart	Discussions on parking and movement problems and possible parking study have been completed.	Inactive
8	Huntington	Review of Huntington progress from study made in 1953 was conducted and together with a planning consultant recommendations for present were made.	Active
9	Brazil	Discussions on setting up an engineering group within the city have been conducted.	Inactive
10	Lake County	Request for assistance was answered. Discussion resulted in conclusion that county needed a complete study by an engineering firm.	Inactive
11	Anderson	Assistance given City Engineer on street classification for city.	Complete
12	Jay County	Road classification study in progress. Inventory done by State.	Active
13	Greensburg	Advice given to city Safety Committee on operation of city streets.	Inactive

The procedure for a city or county to obtain the services of the Unit are well established and all inquiries for services to date have been quickly fulfilled. Acceptance of some of the services has been rejected in a few cases where the city did not wish to expend the funds required.

PERSONNEL OF JOINT HIGHWAY RESEARCH PROJECT

June 30, 1957

Advisory Board

C. E. Vogelgesang (State Highway Department of Indiana), Chairman

J. R. Cooper (State Highway Department of Indiana)

J. T. Hallett (State Highway Department of Indiana)

F. F. Havey (State Highway Department of Indiana)

*J. E. Wilson (State Highway Department of Indiana)

K. B. Woods (Purdue), Vice-Chairman

**D. S. Berry (Purdue)

G. A. Leonards (Purdue)

R. E. Mills (Purdue)

B. H. Petty (Purdue)

J. L. Waling (Purdue)

***H. L. Michael (Purdue), Secretary

* Mr. Wilson replaced Mr. Poindexter effective April, 1957.

** Professor Berry replaced Professor Lewis, effective July 1, 1956.

*** Non-voting member.

Record of Meetings and Attendance

The Joint Highway Research Project Advisory Board July 1, 1956 - June 30, 1957

Meeting No.	166	167	168	169	170	171	172	173	174	Total	
Members	July 26	Sept. 26 (4)	Nov. 1 (5)	Dec. 5	Jan. 24 (6)	Feb. 21	Apr. 4 (7)	May 9	June 12	Present	Absent
D. S. Berry (1)	X	A	A	X	X	X	X	X	X	7	2
J. R. Cooper	X	X	X	X	X	X	X	X	X	89	8
J. T. Hallett	X	X	X	X	X	A	X	X	X	96	7
F. F. Havey	X	X	X	X	X	A	X	X	X	132	8
G. A. Leonards	X	X	X	X	X	A	X	X	A	15	2
R E. Mills	X	X	X	A	X	X	X	X	X	52	2
B H. Petty	A	X	X	X	A	X	X	X	X	137	21
Lloyd Poindexter	A	X	A	A	A	X	-	-	-	8	7
C E Vogelgesang (Chm)	X	X	A	X	X	X	X	X	X	89	1
J. L. Waling	A	A	X	X	X	X	X	X	X	14	3
J. E Wilson (2)	-	-	-	-	-	-	X	A	X	2	1
K. B. Woods (V.Chm)	X	X	X	X	X	X	X	X	X	157	0
H L. Michael (3)(Secty)	X	X	X	X	X	X	X	X	S	27	0

(1) Appointed to replace Professor B. B. Lewis, effective July 1, 1956.
(2) Appointed to replace Mr. Lloyd Poindexter, effective April 1957.
(3) Non-voting member.
(4) Guests: Messrs. M. B. Scott, W T. Spencer, and VonRoy Dougherty
(5) Guests: Messrs. B. B Lewis, S. Paul Clay, and Jack Stader.
(6) Guests: Messrs. George Barton, W. T. Bilby, and M J. Gutzwiller.
(7) Guest: Mr. W. T. Spencer

Research Staff

Director

K. B. Woods

Assistant Director

H. L. Michael

Highway Specialist

B. H. Petty

Research Engineers

D. S. Berry	(In charge, Traffic)
D. O. Covault	(Traffic)
W. H. Goetz	(In charge, Bituminous)
F. H. Green	(Traffic)
C. W. Lovell, Jr.	(Soils)
J. F. McLaughlin	(In charge, Concrete)
R. D. Miles	(In charge, Airphoto)
W. W. Mylrois (Mrs.)	(Economics)
Merle Parvis	(Airphoto)
L. E. Wood	(Bituminous)
P. T. Yeh	(Airphoto)
E. J. Yoder	(In charge, Soils)

Research Associates

A. K. Branham	(In charge, Economics)
W. L. Dolch	(In charge, Chemistry)

Research Assistants

P. D. Cribbins	(Economics)
M. E. Harr	(Special Project)
R. L. Schuster	(Concrete)
D. G. Shurig	(Airphoto)

Graduate Assistants

D. H. Bailey	(Airphoto)	Charles Pinnell	(Traffic)
Delon Hampton	(Soils)	J. H. Schaub	(Soils)
Mart Kask	(Traffic)	C. F. Scholer	(Soils)
T. F. McMahon	(Soils)	P. M. Weckesser	(Traffic)
K. E. McNaughton	(Traffic)		

Service

E. L. Black	(Photographer and Duplicating)
W. B. Luttrell	(Shop)
Morris Stewart	(Laboratory Assistant)

Clerical

Helen Beasley	(Stenographer)
Nancy Foxworthy	(Purchasing)
Edna Liu	(Typist)

Date of Appointment of Present Staff

Name	Present Title	Appointed
Bailey, Dale H.	Graduate Assistant	September 1, 1956
Beasley, Helen	Stenographer	September 10, 1956
Berry, D. S. (3)	Research Engineer	July 1, 1956
Black, E. L.	Laboratory Technician	November 1, 1953
Branham, A. K.	Research Associate	September 1, 1939 (A)
Covault, D. O.	Research Engineer	September 22, 1955
Cribbins, P. D.	Research Assistant	February 1, 1957
Dolch, W. L. (1)	Research Associate	September 15, 1947
Foxworthy, Nancy	Purchasing Clerk	March 18, 1957
Goetz, W. H. (3)	Research Engineer	May 13, 1938
Green, F. H. (2)	Research Engineer	February 1, 1945
Hampton, Delon	Graduate Assistant	February 1, 1957

Name	Present Title	Appointed
Harr, M. E.	Research Assistant	February 1, 1956
Kask, Mart	Graduate Assistant	June 11, 1956 (C)
Liu, Edna	Typist	September 1, 1955
Lovell, C. W. (1)	Research Engineer	September 1, 1948
Luttrell, W. B.	Laboratory Assistant	August 6, 1938
McLaughlin, J. F. (1)	Research Engineer	September 1, 1950
McMahon, T. F.	Graduate Assistant	June 1, 1957
McNaughton, K. E.	Graduate Assistant	June 11, 1956
Michael, H. L. (1)	Assistant Director	February 1, 1950
Miles, R. D. (1)	Research Engineer	September 1, 1949
Mylroie, Willa (Mrs.) (2)	Research Engineer	August 10, 1956
Parvis, Merle (2)	Research Engineer	March 1, 1946
Petty, B. H. (3)	Highway Specialist	July 1, 1936
Pinnell, Charles	Graduate Assistant	June 1, 1957
Schaub, J. H.	Graduate Assistant	June 1, 1957
Scholer, Charles F.	Graduate Assistant	September 20, 1956
Schuster, R. L.	Research Assistant	February 1, 1957
Shurig, D. G.	Research Assistant	February 1, 1955
Stewart, Morris R.	Laboratory Assistant	June 1, 1957
Weckesser, P. M.	Graduate Assistant	September 17, 1956
Wood, L. E. (1)	Research Engineer	September 1, 1953
Woods, K. B. (4)	Director	February 1, 1939
Yeh, P. T.	Research Engineer	February 1, 1953
Yoder, E. J. (2)	Research Engineer	September 1, 1949 (B)

(1) Assistant Professor
(2) Associate Professor
(3) Professor
(4) Head

(A) Resigned August 18, 1941 and reappointed August 1, 1949.

(B) Resigned December 31, 1947 and reappointed September 1, 1949.

(C) Resigned July 31, 1956 and reappointed September 1, 1956.

In addition Mr. William Prescott, professional engineer, has been assigned to the Project by the State Highway Department of Indiana since November 1956 to use the Kelsh Plotter.

NEW STAFF MEMBERS DURING PAST YEAR
July 1, 1956 to June 30, 1957

Name	Rank	Degree Held	School	Date Appointed
Antrim, John deC.	Graduate Assistant	BSCE, 1956	Lehigh University	September 1, 1956
Bailey, Dale A.	Graduate Assistant	BSCE, 1956	University of Saskatchewan	September 1, 1956
Cribbins, Paul D.	Research Assistant Instructor in Engineering Graphics	BSCE, 1952 MSCE, 1957	University of Alabama Purdue University	February 1, 1957
Dennis, John H.	Graduate Assistant	BS, 1957	Pennsylvania State University	January 28, 1957
Ender, Hayim V.	Graduate Assistant	BSCE, 1953 MSCE, 1954	Robert College, Turkey Purdue University	November 1, 1956
Hampton, Delon	Graduate Assistant	BSCE, 1954	University of Illinois	February 1, 1957
Kask, Mart*	Graduate Assistant	BSCE, 1956	St. Martin's College	September 1, 1956
Kocataskin, Ferruh M.	Research Assistant	Higher CE, 1947 Dr.-Ing, 1953 Univ. Docent, 1955	Istanbul Teknik Univeritesi Technische Hochschule, Stuttgart Teknik Universitesi, Istanbul	August 1, 1956
Lowry, Robert H.	Graduate Assistant	BSCE, 1954	Purdue University	February 1, 1957

* This is a reappointment; Mr. Kask was last on the staff June 11, 1956 to July 31, 1956.

Name	Rank	Degree Held	School	Date Appointed
McMahon, T. F.	Graduate Assistant	BSCE, 1947 MSCE, 1949	Kansas State College Columbia University	June 1, 1957
Mylroie, Willa W.	Research Engineer Assoc. Professor of Civil Engineering	BSCE, 1940 MS*, 1952	University of Washington University of Washington	August 10, 1956
Pinnell, Charles	Graduate Assistant	BSCE, 1952	Texas Tech	June 1, 1957
Schaub, J. H.	Graduate Assistant	BSCE, 1948 MSCE, 1949	Virginia Polytechnic Inst. Harvard University	June 1, 1957
Scholer, Charles F.	Graduate Assistant	BSCE, 1956	Kansas State College	September 20, 1956
Schuster, Robert L.	Research Assistant	BSGeology, 1950 MSGeology, 1952	State College of Washington Ohio State University	February 1, 1957
Weckesser, Paul M.	Graduate Assistant	BSCE, 1956	University of Detroit	September 17, 1956
Woo, John C. H.	Graduate Assistant	BS**, 1956	Purdue University	October 1, 1956
Yang, Cheng Y.	Graduate Assistant	BS, 1953	National Tainan University	September 1, 1956
Beasley, Helen G.	Stenographer			September 10, 1956
Foxworthy, Nancy	Purchasing Clerk			March 18, 1957
Peters, Carolyn	Purchasing Clerk			August 20, 1956
Stewart, Morris R.	Laboratory Assistant			June 1, 1957

* In Regional Planning

** In Air Transportation

STAFF RESIGNATIONS DURING THE PAST YEAR*

July 1, 1955 to June 30, 1956

Name	Title	Degrees Held	School	Appointed	Resigned
Alcock, D. H.	Graduate Assistant	BS, 1955	Alabama Polytechnic Inst.	7/1/56	8/31/56
Anderson, R. L.	Research Engineer	BSEE, 1939 MSE, 1948	Purdue University Purdue University	10/16/53	1/31/57
Antrim, John deC	Graduate Assistant	BSCE, 1956	Lehigh University	9/1/56	5/31/57
Chamberlin, William P.	Graduate Assistant	BS, 1955 MSCE, 1957	University of Maryland Purdue University	9/1/55	6/20/57
Dennis, John H.	Graduate Assistant	BS, 1957	Pennsylvania State Univ.	1/28/57	5/31/57
Dunkin, J. W.	Research Assistant	BSE, 1952 MSE, 1953	Purdue University Purdue University	7/1/54	8/31/56
Ender, Hayim V.	Graduate Assistant	BSCE, 1953 MSCE, 1954	Robert College, Turkey Purdue University	11/1/56	5/31/57
Geldmacher, R. C.	Research Engineer	BE, 1942 MS, 1946	Northern Illinois State Teachers College Purdue University	10/16/53	8/31/56
Ioakimidis, C.	Graduate Assistant	BSCE, 1952	National Technical University of Athens, Greece	6/1/56	7/31/56
Kask, Mart	Graduate Assistant	BSCE, 1956	St. Martin's College	6/11/56	7/31/56

Name	Title	Degrees Held	School	Appointed	Resigned
Kocataskin, Ferruh M.	Research Assistant	Higher CE, 1947 Dr.-Ing., 1953 Univ. Docent, 1955	Istanbul Teknik Universitesi Technische Hochschule, Stuttgart Teknik Universitesi, Istanbul	8/1/56	6/30/57
Lowry, Robert H.	Graduate Assistant	BSCE, 1954	Purdue University	2/1/57	5/31/57
Midgaard, E. J.	Graduate Assistant	CE 1952 MSCE, 1957	Norway Inst. of Tech. Purdue University	9/1/55	1/31/57
Miller, Melton M.,Jr.	Research Assistant	BSCE, 1955	University of Vermont	2/1/57	6/30/57
Oppenlander, Joseph C	Research Assistant Instructor in Civil Engineering	BSCE, 1953 MSCE, 1957	Case Institute of Technology Purdue University	9/1/55	6/30/57
Woo, John C. H.	Graduate Assistant	BS*, 1956	Purdue University	10/1/56	6/30/57
Yang, Cheng Y.	Graduate Assistant	BS, 1953	National Tainan Univ.	9/1/56	1/30/57
Deardorff, Beverlee	Clerk-Typist			10/1/55	2/15/57
English, Margaret	Clerk-Typist			9/6/55	8/31/56

* In Air Transportation

Name	Title	Degrees Held	School	Appointed	Resigned
Henning, R. J.	Laboratory Assistant			6/1/56	9/15/56
McLaughlin, S. B.	Topographical Draftsman			12/1/53	9/1/56
Peters, Carolyn	Purchasing Clerk			8/20/56	4/23/57
Sutton, J. A.	Laboratory Assistant			6/1/56	9/15/56

* For a summary of staff resignations from July 1, 1936 to June 30, 1955, see the Annual Report of the Assistant Director, 1954-55. See annual report of each year, 1955-56 and thereafter, for other resignations.

CHANGES IN RANK OR TITLE

Name	Old Title	Present Title	Effective Date	Degree	School	Date
Dolch, William L.	Research Assistant Instructor of Highway Engineering	Ass't. Prof. of Highway Eng. Research Associate	July 1, 1956	BSChE MS Ph.D.	Purdue Univ. Purdue Univ. Purdue Univ.	1947 1949 1956
Goetz, William H.	Research Engineer Associate Prof. of Highway Engineering	Prof. of Highway Engineering Research Engineer	July 1, 1956	BSChE MSChE	Univ. of Mich. Purdue Univ.	1936 1942
Lovell, C. W., Jr.	Research Engineer Instructor of Civil Engineering	Ass't. Prof. of Civil Engineering Research Engineer	February 1, 1957	BCE MSCE Ph.D.	Univ. of Louisville Purdue Univ. Purdue Univ.	1944 1951 1957
McLaughlin, John F.	Research Engineer Instructor of Civil Engineering	Ass't Prof. of Civil Engineering Research Engineer	February 1, 1957	BCE MSCE Ph.D.	Syracuse Univ. Purdue Univ. Purdue Univ.	1950 1953 1957
Miller, Melton M., Jr.	Graduate Ass't.	Research Assistant	February 1, 1957	BSCE	Univ. of Vermont	1955
Oppenlander, Joseph C.	Graduate Ass't.	Research Assistant Instructor in Civil Engineering	September 1, 1956	BSCE MSCE	Case Inst. of Tech. Purdue Univ.	1953 1957
Wood, Leonard E.	Research Engineer Instructor of Civil Engineering	Ass't. Prof. of Civil Engineering Research Engineer	September 1, 1956	BS MS Ph.D.	Kansas State Col. Kansas State Col. Purdue Univ.	1948 1949 1956

LEAVES OF ABSENCE

Name	Title	Degrees	School	Appointed	From	To
Covault, D. O.	Research Engineer	BSCE, 1948 MSCE, 1950	Purdue University Purdue University	9/22/55	6/1/57	9/30/57

STAFF ACTIVITIES DURING PAST YEAR

Donald S. Berry, Professor of Transportation Engineering, was author of a paper "Field Measurement of Delay at Signalized Intersections" that was published by the Highway Research Board. He also was author of a paper presented at the 43rd Annual Purdue Road School entitled "What Can be Done to Train a Traffic Engineer" and presented numerous speeches on traffic problems at various civic clubs and professional groups. He also assisted in traffic short courses at Michigan State and Northwestern Universities.

Professor Berry is chairman of the Department of Traffic and Operation of the Highway Research Board and a member of four technical committees of that organization. He is a member of the Technical Council of the Institute of Traffic Engineers and Head of Department 2. He also is a member of the National Committee on Uniform Traffic Control Devices, member of National Committe on Uniform Traffic Laws and Ordinances, member of National Committee on Traffic Training, chairman of Speed Committee of National Safety Council, chairman of the National Advisory Committee on Traffic Engineering Training, and a member of subcommittee 4 of National Committee on Urban Transportation.

Professor Berry is also a member of the West Lafayette Traffic Commission and a member and technical advisor of the Citizens subcommittee on Parking. He was director of a short course on "Fundamentals of Traffic Engineering" held at Purdue in August, 1956, and is an advisor to the Physical Plant of Purdue on subdivision layout and street planning. He also is chairman of the Transportation Engineering Curriculum Committees and is a member of the Schools of Engineering Committee on Unprecedented Enrollment Problems as well as a member of numerous Civil Engineering committees.

During the year Professor Berry attended numerous meetings of professional groups including the Institute of Traffic Engineers meeting in San Francisco, the Highway Research Board meeting in Washington, the American Road Builders Association Convention in Chicago, and the American Society of Civil Engineers and the Institute of Traffic Engineers meetings in Indianapolis.

A. K. Branham, Research Associate, presented papers "The St. Lawrence Seaway - Economic and Social Implications," to the Association of Girl Scout Professional Workers; "Selection and Retention of Civil Engineers" at the 43rd Annual Purdue Road School; and "Highway Highlights of 1956 and the Challenge Ahead" at the Tennessee Highway Conference at Knoxville, Tennessee. He also was coauthor (with D. O. Covault and H. L. Michael) of the paper "Summary Report on State Highway Needs in Indiana" presented at the Purdue Road School.

Mr. Branham was coauthor of the paper "Progress Report on State Highway Needs in Indiana" that was published in the Proceedings of the 42nd Annual Road School, Purdue University in September 1956. He gave two talks, one to the 23rd Annual Indiana State Fire School and the other to the Howard County Planning Commission on the subject "Rural Road Marking." He also discussed this same subject before interested groups in Kokomo, Peru, and Delphi, Indiana.

Mr. Branham is a member of the Dept. of Economics, Finance and Administration of the Highway Research Board, Chairman of the Committee on Highway Taxation and Finance and a member of three other committees of that Department. He served as consultant to the County Commissioners' Association of Indiana,

as secretary to the Civil Engineering Faculty, as Chairman of the Civil Engineering Committee on Annual Reports and the Committee on Catalog. He is a member of nine other Civil Engineering Committees and is registration deputy of the graduate program in Civil Engineering

During the year, Mr. Branham attended the Annual Meeting of the Highway Research Board in Washington, D. C., January 7-11; the American Road Builders' Association Convention in Chicago January 29-31; and nine other professional meetings.

Donald O. Covault, Research Engineer, was coauthor (with A. K. Branham and H. L. Michael) of "Progress Report on State Highway Needs in Indiana" that was published in Proceedings of the 42nd Annual Purdue Road School in September 1956. He also presented a paper (again with Branham and Michael) "Summary Report on State Highway Needs in Indiana" at the 43rd Annual Purdue Road School in April 1957. At that same Road School he gave several talks on the extension of the Needs study that is to be performed by the State Highway Department of Indiana.

Mr. Covault also gave two counseling talks to high school students at Tipton and Monon, Indiana on Engineering and Science careers. He attended the Highway Research Board Meeting in January 1957 in Washington, D. C. and six other professional Society Meetings during the year. He became an Associate Member of Sigma Xi and of the Highway Research Board and a new member of the National Society of Professional Engineers during the past year.

Paul D. Cribbins, research assistant and Instructor in Engineering Graphics, received the degree of Master of Science in Civil Engineering in January 1957. He attended the Purdue Road School and the Transportation Symposium held at Purdue during the year.

W. L. Dolch, Research Associate and Assistant Professor of Highway Engineering, was given the latter title upon promotion on July 1, 1956. Professor Dolch is a member of ASTM Committee C-1 on Cement and three Civil Engineering faculty committees. He attended two meetings of Committee 29 of the AREA in Chicago, one in October, the other in May, and the AREA annual meeting in St. Louis in March. He also attended the Purdue Road School.

W. H. Goetz, Research Engineer and Professor of Highway Engineering, was promoted to the latter title on July 1, 1956. He was coauthor of two papers that were published during the year: "The Strength of Bituminous Mixtures and Their Behavior Under Repeated Loads" (with L. E. Wood) Proceedings, HRB, 1956; and "Sonic Test for Evaluation of Stripping Resistance in Compacted Bituminous Mixtures" (with D. B. Andersland) Proceedings, The Association of Asphalt Paving Technologists, 1956. The latter paper was judged the best presented at the 1956 meeting of the Association.

Professor Goetz was also coauthor of three papers presented during the year: "The Strength of Bituminous Mixtures and Their Behavior Under Repeated Loads, Part II" (with L. E. Wood) to the Highway Research Board in Washington, D. C.; "Load Deformation Characteristics of Bituminous Mixtures Under Various Conditions of Loading" (with L. E. Wood and J. F. McLaughlin) to the Association of Asphalt Paving Technologists in Atlanta, Georgia; and "Performance Data for Some Bituminous Concrete Overlays in Indiana" (with J. F. McLaughlin) to the 43rd Annual Purdue Road School. Professor Goetz also presented a talk, "Limitations of the Marshall Method," to the Michigan Asphalt Paving Conference in Lansing, Michigan in March 1957.

Professor Goetz is First Vice President of the Association of Asphalt Paving Technologists, Chairman of the Highway Research Board Committee on

Surface Treatments and a member of three other Highway Research Board Bituminous Committees. He is also chairman of the American Society for Testing Materials, Committee on Effect of Water on Bituminous Coated Aggregate, and a member of eight other ASTM Committees. He is chairman of the Enforcement Committee of the Lafayette Chapter, Indiana Society of Professional Engineers as well as a member of the same committee of the state society. He served as chairman of an ad hoc advisory committee to the Building Research Advisory Board of the National Research Council on "Double Bituminous Surface Treatment of Residential Streets."

Professor Goetz is also chairman of the Civil Engineering Graduate Study Committee and of the Civil Engineering Lectures Committee. He is also a member of eight other Civil Engineering Committees. He was appointed to the Board of Consultants, Corps of Engineers, Flexible Pavements Branch, Vicksburg, Mississippi. He attended 23 professional meetings during the year including Highway Research Board, Association of Asphalt Paving Technologists, and the American Society of Testing Materials.

F. H. Green, Associate Professor of Highway Engineering, served as counselor for 14 advanced Transportation Engineering students who attended Purdue during the past year under fellowships from the International Road Federation. Special courses and projects were developed for this group by Professor Green. He also prepared a manual on highway design standards for borrowing countries for the International Bank for Reconstruction.

Professor Green attended the American Road Builders Association Meeting and the International Road Federation School for foreign highway engineers in Chicago in January. He also was a member of several committees of the Civil Engineering School.

M. E. Harr, Research Assistant, was coauthor of a paper "Subgrade Support Characteristics" presented at the Annual Meeting of the Highway Research Board in Washington, D. C. in January. Other coauthors were R. C. Goldmacher, R. L. Anderson, J. W. Dunkin, G. R. Partridge, and L. E. Wood. He also attended the Annual Purdue Road School in April and was elected to membership in Chi Epsilon and Sigma Xi, the latter as an associate.

F. M. Kocataskin, Research Assistant, was appointed to the Purdue staff to do post-doctoral research on August 1, 1956. He was author of a paper published as a Bulletin of the Technical University of Istanbul in 1956 and entitled, "Vapor Permeability of Concrete." He attained membership in the Highway Research Board and Sigma Xi during the year and attended the Ready-Mix Concrete Conference and the Purdue Road School, both at Purdue University.

C. W. Lovell, Jr., Research Engineer and Assistant Professor of Civil Engineering, received the Ph.D. degree from Purdue University in January 1957. His thesis was entitled "Certain Characteristics of Partially Frozen Soil." Professor Lovell also authored "Temperature Effects on Phase Composition and Strength of Partially Frozen Soil" that was presented at the annual meeting of the Highway Research Board in January, 1957. He is a member of four Civil Engineering Committees, being chairman of the Committee on Geology and Camp. Since January 1957 he has attended several meetings of professional organizations.

John F. McLaughlin, Research Engineer and Assistant Professor of Civil Engineering, completed the requirements of the Ph.D. degree in

January 1957 and was subsequently promoted from the rank of Instructor. His thesis "The Load Carrying Characteristics of A Bituminous Concrete Resurfacing Mixture" was also completed in January. With R. D. Walker as coauthor their paper "Effect of Heavy Media Separation on Durability of Concrete Made with Indiana Gravels" was published by the Highway Research Board in Bulletin 143.

Mr. McLaughlin presented three papers during the year: "Alkili Aggregate Reaction in Indiana" to the Highway Research Board; "Load-Deformation Characteristics of Bituminous Mixtures Under Various Conditions of Loading" (with W. H. Goetz and L. E. Wood) to the Association of Asphalt Paving Technologists, and "Performance Data for Some Bituminous Concrete Overlays in Indiana" (with W. H. Goetz) to the 43rd Purdue Road School. He also presented two talks to the Mid-West Ready Mixed Concrete Association, one at Purdue and one in Chicago, on the subjects "Current Research on Concrete Materials" and "Cylinder Testing." He also participated in the planning of a Ready Mixed Concrete Conference at Purdue in December.

Mr. McLaughlin is a member of the Highway Research Board Committee on Aggregates and the Committee on Concrete Durability; of ASTM Committee C-9 on Concrete and Concrete Aggregate and several subcommittees of C-9; and the American Concrete Institute Committee 215 on Fatigue of Concrete. He also became a member of the National Society of Professional Engineers during the past year.

Mr. McLaughlin is Chairman of the Civil Engineering Fund Committee and a member of five other Civil Engineering Committees. He attended the annual meeting of the Highway Research Board in Washington in January, the American Concrete Institute Meeting in Dallas, Texas in February, the

Chicago District Meeting of ASTM in Chicago last October, the Midwest Ready Mixed Concrete Association Meeting in Chicago in March and several other professional meetings.

H. L. Michael, Assistant Director of the Joint Highway Research Project and Assistant Professor of Highway Engineering, was coauthor (with D. L. Grunan) of a paper entitled "Development of Skid Testing in Indiana" published in Bulletin 139 of the Highway Research Board in 1956. He was also editor of a paper entitled "Improvement Priority Ratings for Local Rural Roads in Indiana" (from material prepared by J. E. Baerwald and P. E. Henebry) Proceedings, 42nd Annual Road School, Purdue University, September 1956. With D. O. Covault and A. K. Branham, he was author of "Progress Report on State Highway Needs in Indiana" which also appeared in the 42nd Road School Proceedings. An article by him and entitled "Rapid Transit" was also published in the New International 1957 Year Book - Events of 1956.

Professor Michael also presented a paper entitled "Traffic Engineering and Safety" at the Regional Conference of the International Road Federation in Antigua, Guatemala, in November 1956. He also presented "Traffic Engineering for the Small City" to the Traffic Engineers at the Purdue Road School and was coauthor (with D. O. Covault and A. K. Branham) of "Summary Report on State Highway Needs in Indiana" that was presented at the same Road School. During the year, Professor Michael presented eight talks on several subjects to Citizens Groups, safety Councils, high schools, and Chambers of Commerce. He also presented a television program over WTTV on "Too Many or Too Few."

Professor Michael is a member of the Traffic and Operations Department of the Highway Research Board; chairman of the Speed Characteristics Committee

of that Department; a member of three other committees of the Highway Research Board; a member of Committee 9 - Highways of American Railway Engineering Association; a member of Committee 2C - Traffic Engineering Education of the Institute of Traffic Engineers; and vice president of the Lafayette Chapter of the Indiana Society of Professional Engineers. He is also commanding officer of the 477th SI Detachment, a reserve unit; Chairman of the West Lafayette Traffic Commission and Chairman of the Thoroughfare subcommittee of the Citizens Traffic Committee of West Lafayette.

During the year, Professor Michael provided traffic engineering advice as an extension service to nine Indiana cities and counties. He is assistant advisor to Theta Xi Fraternity; a member of the University Committee on the Automobile Problem; a member of the Engineering Experiment Station Committee on Publications; Chairman of the Civil Engineering Committee on Reprints; and a member of eight other Civil Engineering Committees. He attended 19 professional meetings during the year including an Economic Impact of Highways Conference in Washington, D. C. and an American Railway Engineering Association Committee Meeting in Chicago.

Robert D. Miles, Research Engineer and Assistant Professor of Highway Engineering, presented a paper entitled "Consideration on Equipment, Methods and Standards of Accuracy Applicable to Aerial Surveys for Different Purposes" to the annual meeting of the Highway Research Board in Washington, D. C. He also presented a talk "Foresight and Backsight" to the County Engineers and Surveyors in Indianapolis in December 1956.

Professor Miles is a member of the Photogrammetry and Aerial Surveys Committee of the Highway Research Board, a member of the Citizens Street Improvement Committee of West Lafayette, and is a Captain in the 477th

Strategic Intelligence Detachment, a reserve unit.

During the year Professor Miles supervised the preparation of photogrammetric aerial mosaics for 21 State Institutions under the authority of the Bureau of the Budget of the State of Indiana. He is a member of the University Military affairs Committee, a counselor and a member of three Civil Engineering Committees. He attended the Highway Research Board meeting in Washington in January and a meeting of the Highway Research Board Photogrammetry and Aerial Surveys Committee in Columbus, Ohio in August 1956.

M. M. Miller, Jr., Research Assistant and Instructor in Structural Engineering, became a student member of the American Concrete Institute during the year. He was appointed to his present position from graduate assistant on February 1, 1957. During the year he attended the University of Illinois Structural Conference at Illinois and a Plastic Design Conference at Purdue in addition to several meetings of local professional societies.

Willa W. Mylroie, Research Engineer and Associate Professor of Civil Engineering, was coauthor of "Washington State Highway Cost Allocation Study" presented at the Highway Research Board in Washihgton, D. C. in January 1957. Mrs. Mylroie is also a member of the Committee on Highway Taxation and Finance of the Highway Research Board, a counselor in the School of Civil Engineering and a member of several Civil Engineering Committees.

Mrs. Mylroie was appointed to the staff from the State of Washington in August 1956. She became a member of the American Society of Engineering Education and Sigma Xi during the year. She attended the HRB Meeting in Washington and seven other professional group meetings. Mrs. Mylroie

also attended the special Transportation Science Program during the summer session at Purdue University in 1956.

J. C. Oppenlander, Research Assistant and Instructor in Civil Engineering, was appointed to these positions from a graduate assistant on September 1, 1956. He completed his thesis for the MSCE degree in June 1957 and obtained that degree at that time. The title of his thesis was "Triaxial Testing of Bituminous Mixtures at High Confining Pressures."

Ben H. Petty, Highway Specialist and Professor of Highway Engineering, was the author or editor of numerous publications during the year. He edited the "Proceedings, 42nd Annual Road School, Purdue University, 1956;" prepared the "1957 Directory of Indiana State, County, and City Officials Responsible for Road and Street Work" published by Purdue University; and authored 12 issues of "Highway Extension News" published by Purdue monthly.

Professor Petty also, with John Stoner, authored "County Highway Administration in Indiana" a report to the Indiana Commission on Tax and Financing Policy and published by them in 1956. He also authored the following: "First Things First," The Registration Bulletin, No. 69, Dec. 1956; "Pro and Con of Reimbursement for Highways on Interstate System Already Built to Interstate Standards," Engineering News Record Vol. 158, No. 4, pages 64-65, Jan. 24, 1957; "New Road Standards Urged," Construction Digest, Vol. 29, No. 25, page 22, Jan. 31, 1957; "Some Fundamental Principles for Highways," Better Roads, Vol. 27, No. 2, pages 48, 50-52, Feb. 1957; "Highway Fundamentals," Public Works, Vol. 88, No. 4, pages 142-146, April 1957; and "The Importance of Highways in our Daily Living," Proceedings 5th Annual Georgia Highway Conference, Georgia Institute of Technology, pages 1-9, April 1957.

Professor Petty also presented a paper "Highway Fundamentals" at the Wisconsin Highway Conference in Milwaukee and presented eight talks in Chicago and various cities in Indiana on highway subjects. He is a member of the Board of Directors of American Road Builders Association and the Educational Division of that organization as well as a state director of the Indiana Society of Professional Engineers. The latter organization awarded him the honor of "Engineer of the Year" at its annual convention in May 1957.

During the year, Professor Petty participated in numerous extension activities and was the chairman of the 43rd Annual Road School. He is in charge of Civil Engineering Placement and Senior Personnel Records. He is a member of numerous Civil Engineering committees and the University Committee on Promotions. He attended numerous professional meetings during the year in Indiana as well as Washington, D. C.; Point Clear, Alabama; and Chicago.

R. L. Schuster, Research Assistant and Instructor, was appointed to the research staff on February 1, 1957. He attended several meetings of professional geology groups in Bloomington, Indiana; Traverse City, Michigan, and Lafayette, Indiana, during the year.

Donald G. Shurig, Research Assistant, completed his work for the MSE degree in January 1957 and submitted as part of that work a thesis entitled "Power Augers and Earth Resistivity Units as Supplements to Drilling Machines." In February he was appointed to his present position from Graduate Assistant.

Mr. Shurig presented a paper "Highway Subsurface Exploration" at the 43rd Annual Purdue Road School in April 1957. He also was elected as an Associate Member of Sigma Xi.

Leonard E. Wood, Research Engineer and Assistant Professor of Civil Engineering, presented as coauthor three papers during the year. "The Strength of Bituminous Mixtures and Their Behavior Under Repeated Loads, Part II" coauthored by W. H. Goetz was presented at the Highway Research Board Meeting in January. At the same meeting the paper "Subgrade Support Characteristics" (R. C. Geldmacher, R. L. Anderson, J. W. Dunkin, G. R. Partridge, and M. E. Harr as coauthors) was also given. Mr. Wood with W. H. Goetz and J. F. McLaughlin presented "Load-Deformation Characteristics of Bituminous Mixtures under Various Conditions of Loading" at the Annual Meeting of the Association of Asphalt Paving Technologists in Atlanta, Georgia in February 1957.

Mr. Wood was also coauthor with W. H. Goetz of a paper "The Strength of Bituminous Mixtures and Their Behavior Under Repeated Loads" published in the Proceedings of the Highway Research Board in 1956 and completed his Ph.D. Thesis "The Stress-Deformation Characteristics of Asphaltic Mixtures under Various Conditions of Loading" in August 1956 at Purdue.

Mr. Wood was promoted to Assistant Professor in September 1956 and assumed full-time teaching duties at that time. He attended the Annual Meetings of the Highway Research Board and the Association of Asphalt Paving Technologists and a meeting of the Society of Plastics Industry during the year. He is a student counselor, a member of Purdue Engineering Education Committee and several committees of the Civil Engineering faculty. He obtained membership in the Association of Asphalt Paving Technologists, American Society of Testing Materials and the American Society of Engineering Education during the year.

K. B. Woods, Head, School of Civil Engineering and Director of Joint Highway Research Project, was very active in professional organizations. He was Chairman of the Highway Research Board for 1956, a member of its executive committee, a member of the Department on Material and Construction and the Department of Soils, Geology and Foundation, and a member of several technical committees. He also is chairman of the Advisory Committee for the American Association of State Highway Officials Road Test and during the year was elected First Vice-President of the American Society for Testing Materials. In that organization he is also chairman of Committee D-4 "Road and Paving Materials"; a member of Executive Subcommittee C-9, "Concrete and Concrete Aggregates," and a member of Executive Committee D-18, "Soils for Engineering Purposes."

Professor Woods is also a member of Committee 325 of the American Concrete Institute on "Structural Design of Concrete Pavement for Highways and Airports," a member of Committee on Permafrost of The American ~~Concrete~~ Society of Civil Engineers ~~Institute~~, and a member of the Indiana Flood Control and Water Resources Commission. He also is a consultant to the Corps of Engineers, U. S. Army.

During the year, Professor Woods gave "Chairman's Address to Thirty-Sixth Annual Meeting" of the Highway Research Board. This address was published in Highway Research Abstracts. With C. E. Vogelgesang, he also authored "Combatting Indiana's Highway Engineering Shortage through Educational and Training Programs" published in American Highways in May 1957.

Professor Woods also presented five papers during the year: "Soil Exploration for Site Selection and Engineering Design" to the American Society for Testing Materials in Los Angeles, California; "Highway Research and Highway Engineering Curriculum" to the Canadian Good Roads Association

in Quebec City, Canada; "Engineering Problems Encountered in the Construction of the Labrador Railroad" to District 9 Council of American Society of Civil Engineers in Dayton, Ohio; "Highway Research and the Expanded Highway Construction Program" to the National Research Council in Washington, D. C.; and "Economic Utilization of Engineering Materials for Highway and Airport Pavement Construction" to the Asphalt Paving Technology Seminar at Berkely, California.

Professor Woods also gave about a dozen talks to various groups on several subjects during the year and these varied from Arctic experience presentations to addresses of welcome to discussion on rigid pavement design.

Professor Woods is a member of the Purdue Research Foundation Council, member of special ad hoc advisory committee to the President of Purdue to coordinate University and Legislature activities, and a member of the nominating committee of Sigma Xi. During the year he attended many Professional meetings including thirty outside of Lafayette.

P. T. Yeh, research engineer and instructor, was active in the Lafayette Chapter of the Indiana Society of Professional Engineers during the year. He also attended the Purdue Road School.

E. J. Yoder, Research Engineer and Associate Professor of Highway Engineering, was coauthor (with J. R. Bell) of "Plastic Moisture Barriers for Highway Subgrade Protection" published in the Proceedings of the 42nd Annual Road School, September 1956. He also presented a paper at the 43rd Annual Purdue Road School in April 1957 entitled "Principles of Soil Stabilization." Professor Yoder was also author or coauthor of three papers presented to the Annual Meeting of HRB in January 1957 in Washington, D. C. The titles of these papers were "Pumping of Highway and Airfield Pavements," "Plastic Moisture Barriers for Highway Subgrade Protection" (coauthored

with J. R. Ball), and "A Study of the Interaction of Subgrade and Base Course Subjected to Repeated Loading" (with J. A. Havers).

Professor Yoder also presented a paper "Pavement Design" at the Kansas Soil Mechanics Conference in Lawrence, Kansas in March, 1957. Two talks on "Highway Design" were given at an Agriculture School Seminar and at a Turf Conference at Purdue. He attended several meetings with representatives of the Corps of Engineers, of committees of the Highway Research Board and the Purdue Road School.

Professor Yoder acted as an advisor to the Physical Plant of Purdue on Street Design and is a member of several Civil Engineering Committees. He is Chairman of the Highway Research Board Committee on Salt Stabilization and a member of the Highway Research Board Committee on Landslides and the Department of Soils.

PUBLICATIONS

Papers, Bulletins, Reprints, and Theses

July 1, 1956 to June 30, 1957

Annual Reports - Engineering Experiment Station*
(From January 1936 to date)

EES Bull.	Vol.	No.	Date	Publications (inclusive)	Period Covered
83	25	5	Sept. 1941	1P - 45P	Jan. 1936 - June 1941
85	26	4	July 1942	46P - 60P	July 1941 - June 1942
91	27	6	Nov. 1943	61P - 73P	July 1942 - June 1943
94	29	1	Jan. 1945	74P - 91P	July 1943 - June 1944
96	29	4	July 1945	92P - 103P	July 1944 - June 1945
100*	31	1	Jan. 1945	104P - 1[illegible]P	July 1945 - June 1946
102	31	5	Sept. 1947	119P - 15[illegible]P	July 1946 - June 1947
107	33	1	Jan. 1949	158P - 176P	July 1947 - June 1948
110	34	2	Mar. 1950	177P - 21[illegible]P	July 1948 - June 1949
113	35	4	July 1951	213P - 243P	July 1949 - June 1950
116	36	3	May 1952	244P - 2[illegible]P	July 1950 - June 1951
119	37	3	May 1953	27[illegible]P - 30[illegible]P	July 1951 - June 1952
120	37	6	Nov. 1953	308P - 345P	July 1952 - June 1953
122	38	6	Nov. 1954	346P - 37[illegible]P	July 1953 - June 1954
126	39	6	Nov. 1955	375P - 4[illegible]P	July 1954 - June 1955
132	40	4	Dec. 1956	401P - 41[illegible]P	July 1955 - June 1956

* Also see EES Bulletin No. 99 which covers a complete listing of publications 1-122P. These Bulletins contain accounts of the various research projects as well as some information on the publications by the staff. The Abstracts Bulletin initiated in 1956 contains a short abstract of each staff publication or thesis.

Abstracts of Engineering Staff Publications and Theses

EES Bull.	Vol.	No.	Date	Includes Publications	Period
133	41	1	March 1957	401P - 44P	July 1, 1955 - June 1956

Reprints

443P "Vibration Study of Three-Span Continuous I-Beam Bridge," by J. M. Hayes and J. A. Sbarounis, Bulletin 124, Highway Research Board, pp. 47-78, 1956 (Civil Engineering Reprint No. 115).

444P "Progress Report on State Highway Needs in Indiana" by A. K. Branham, D. O. Covault and H. L. Michael, Proceedings, 42nd Annual Road School, Extension Series No. 90, Vol. 40, No. 3, Purdue University, pp. 61-85, September 1956 (Civil Engineering Reprint No. 116).

445P "Effect of Crushed-Gravel Fine Aggregate on the Strength of Asphaltic Surfacing Mixtures," by R. P. Lottman and W. H. Goetz, NSGA Circular No. 63, National Sand and Gravel Association, 22 pp., 1956 (Civil Engineering Reprint No. 117).

446P "Plastic Moisture Barriers for Highway Subgrade Protection," by J. R. Bell and E. J. Yoder, Proceedings, 42nd Annual Road School, Extension Series No. 90, Vol. 40, No. 3, Purdue University, pp. 104-115, September 1956 (Civil Engineering Reprint No. 118).

447P "A Study of Bituminous Waterproof Coatings," by J. B. Blackburn, Bulletin 531, Part I, American Railway Engineering Association, Vol. 58, pp. 293-338, September-October 1956 (Civil Engineering Reprint No. 119).

448P "Application of Air Photo Interpretation in the Location of Ground Water," by R. H. L. Howe, H. R. Wilkie, and D. E. Bloodgood, Journal, American Water Works Association, Vol. 48, No. 11, pp. 1380-1390, November 1956 (Civil Engineering Reprint No. 121).

449P "The Strength of Bituminous Mixtures and Their Behavior Under Reported Loads" by L. E. Wood and W. H. Goetz, Proceedings, Highway Research Board, Vol. 35, pp. 405-417, 1956 (Civil Engineering Reprint No. 123).

450P "Improvement Priority Ratings for Local Rural Roads in Indiana," Edited by H. L. Michael from Material by J. E. Baerwald and P. E. Henebry, Proceedings, 42nd Annual Road School, Extension Series No. 90, Vol. 40, No. 3, Purdue University, pp. 116-127, September 1956 (Civil Engineering Reprint No. 124).

451P "Sonic Test for Evaluation of Stripping Resistance in Compacted Bituminous Mixtures," by O. B. Andersland and W. H. Goetz, Proceedings, The Association of Asphalt Paving Technologists, Vol. 25, pp. 148-175, 1956 (Civil Engineering Reprint No. 125).

452P "Effect of Heavy Media Separation on Durability of Concrete Made with Indiana Gravels," by R. D. Walker and J. F. McLaughlin, Bulletin 143, Highway Research Board, pp. 14-26, 1956 (Civil Engineering Reprint No. 126).

Theses

453P "Procedure for Evaluation of Fluvio-Glacial Terraces from Airphotos," A thesis submitted to the faculty of Purdue University by Robert D. Leighty in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering, August 1956.

454P "The Application of Airphotos to Foundation Problems," A thesis submitted to the faculty of Purdue University by Bruce H. Moore in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering, August 1956.

455P "The Stress-Deformation Characteristics of Asphaltic Mixtures Under Various Conditions of Loading," A thesis submitted to the faculty of Purdue University by Leonard E. Wood in partial fulfillment of the requirements for the degree of Doctor of Philosophy, August 1956.

456P "A Study of the Air-Void Characteristics of Hardened Concrete," A thesis submitted to the faculty of Purdue University by Fulton K. Fears in partial fulfillment of the requirements of the degree of Doctor of Philosophy, January 1957.

457P "Certain Characteristics of Partially Frozen Soil," A thesis submitted to the faculty of Purdue University by C. W. Lovell, Jr., in partial fulfillment of the requirements for the degree of Doctor of Philosophy, January 1957.

458P "The Load-Carrying Characteristics of a Bituminous Concrete Resurfacing Mixture," A thesis submitted to the faculty of Purdue University by John F. McLaughlin in partial fulfillment of the requirements for the degree of Doctor of Philosophy, January 1957.

459P "Creep and Shrinkage Strains in Prestressed Concrete Using Two Typical Indiana Aggregates," A thesis submitted to the faculty of Purdue University by Einar J. Midgaard in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering, January 1957.

460P "Power Augers and Earth Resistivity Units as Supplements to Drilling Machines," A thesis submitted to the faculty of Purdue University by Donald G. Shurig in partial fulfillment of the requirements for the degree of Master of Science in Engineering, January 1957.

461P "The Effect of Base Course Gradation on the Results of Laboratory Pumping Tests," A thesis submitted to the faculty of Purdue University by W. P. Chamberlin in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering, June 1957.

462P "Triaxial Testing of Bituminous Mixtures at High Confining Pressures," A thesis submitted to the faculty of Purdue University by J. C. Oppenlander in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering, June 1957.

Papers Published
(See also list of Reprints)

463P "Field Measurement of Delay at Signalized Intersections," by Donald S. Berry, Proceedings, Highway Research Board, Vol. 35, pp. 505-522, 1956.

464P "The Importance of Highways in Our Daily Living," by B. H. Petty, Proceedings, 5th Annual Georgia Highway Conference, Georgia Institute of Technology, Atlanta, p. 1-9, April 1957.

465P "Highway Fundamentals," by B. H. Petty, Public Works, Vol. 88, No. 4, pp. 142-146, April 1957.

466P "Some Fundamental Principles for Highways," by B. H. Petty, Better Roads, Vol. 27, No. 2, p. 48, 50-52, February 1957.

467P "County Highway Administration in Indiana," by B. H. Petty and John E. Stoner, Commission on State Tax and Financing Policy, September 1956.

468P "Combatting Indiana's Highway Engineering Shortage Through Educational and Training Programs," by K. B. Woods and C. E. Vogelgesang, American Highways, May 1957.

469P "Chairman's Address to Thirty-Sixth Annual Meeting," by K. B. Woods, Highway Research Abstracts, Vol. 27, pp. 27-37, February 1957.

470P "Vapor Permeability of Concrete," by Ferruh M. Kocataskin, Bulletin of the Technical University of Istanbul, Vol. 9, pp. 53-59, 1956.

471P "Road Roughness Measurements on Indiana Pavements," by F. M. Holloway Proceedings, 42nd Annual Road School, Extension Series No. 90, Vol. 40, No. 3, Purdue University, pp. 88-103, September 1956.

472P "Development of Skid Testing in Indiana," by D. L. Grunan and H. L. Michael, Bulletin 139, Highway Research Board, pp. 60-78, 1956.

Note 1. In addition, "Proceedings of the 42nd Annual Purdue Road School," Extension Series No. 90, Vol. 40, No. 3, September 1956, 175 pp.; "1957 Directory, Indiana State, County, and City Highway Officials," 27 pp.; and "Highway Extension News" monthly, 12 issues, 2 pp. each were edited by B. H. Petty and published by the Joint Highway Research Project.

JOINT HIGHWAY RESEARCH PROJECTS AND ADVISORY BOARD REPORTS
July 1, 1956 to June 30, 1957

Report and No.	Proj. C-36	Author	Date	Pages	Figs.	Bk.	Vol.	No.	Pt.	Pg.
847-Progress Report No. 33 on "A Study of the Relative Support Characteristics of Nine Subgrade Treatments"	A	Goldmacher	7/26	1	0	119	XVIII	3	A	2
848-Final Report "Airphoto Interpretation of Soils of St. Joseph County, Indiana" (1956 JHRP Report No. 30)	51B	Yeh	7/26	38	11	119	XVIII	3	A	3
849-Final Report "Procedure for Evaluation of Fluvio-Glacial Terraces from Airphotos"(1956 JHRP Report No. 28)	51H	Leighty	7/26	94	10	119	XVIII	3	A	41
850-Final Report "The Application of Airphotos to Foundation Problems" (1956 JHRP Report No. 29)	36F	Moore	7/26	98	16	119	XVIII	3	A	136
851-Final Report "Airphoto Interpretation of Drainage Features of Kosciusko County, Indiana" (1956 JHRP Report No. 26)	51A	Parvis	7/26	10	1	119	XVIII	3	A	224
852-Final Report "Airphoto Interpretation of Drainage Features of Marshall County, Indiana"(1952 JHRP Report No. 27)	51A	Parvis	7/26	10	1	119	XVIII	3	A	234
853-Plan of Study "Shearing Characteristics of Soils"	14B	Yoder Wood	7/26	9	3	119	XVIII	3	A	244
854-Annual Report of Assistant Director, 1955-1956 (1956 JHRP Report No. 31)	--	Michael	7/26	77	0	119	XVIII	3	A	253

Report and No.	Proj. C-36	Author	Date	Pages	Figs.	Bk.	Vol.	No.	Pt.	Pg.
855-Proposed Budget for the Period October 1 - December 31, 1956	---	Michael	9/26	6	0	120	XVIII	3	B	2
856-Progress Report No. 5 "Skid Resistance Study of the U. S. 31 Test Road" (1956 JHRP Report No. 36)	53E	Shupe	9/26	14	2	120	XVIII	3	B	8
857-Progress Report No. 3 "Skid Resistance Study of Experimental Federal Aid Project F-147 (6)" (1956 JHRP Report No. 37)	53H	Shupe	9/26	10	1	120	XVIII	3	B	21
858-Progress Report No. 1 "Skid Resistance - Study on the Experimental Test Section of U. S. 421 South of Kirklin" (1956 JHRP Report No. 35)	53	Shupe	9/26	7	1	120	XVIII	3	B	31
859-Final Report "The Stress-Deformation Characteristics of Asphaltic Mixtures under Various Conditions of Loading" (1956 JHRP Report No. 32)	6J	Wood	9/26	187	59	120	XVIII	3	B	38
860-Progress Report No. 34 "A Study of the Relative Support Characteristics of Nine Subgrade Treatments"	A	Goldmacher	9/26	1	0	120	XVIII	3	B	225
861-Progress Report No. 59 "Traffic Speeds - Truck Weight - Speed Study" (1956 JHRP Report No. 33)	10D	Henning	9/26	20	6	120	XVIII	3	B	226
862-Progress Report No. 60 "Traffic Speeds" (1956 JHRP Report No. 34)	10C	Henning	9/26	18	6	120	XVIII	3	B	246

Report and No.	Proj. C-36	Author	Date	Pages	Figs.	Bk.	Vol.	No.	Pt.	Pg.
863-Progress Report Nos. 35 and 36 "A Study of the Relative Support Characteristics of Nine Subgrade Treatments"	A	Geldmacher	11/1	3	0	121	XVIII	4	A	2
864-Technical Paper "A Fourteen Channel Displacement Measuring Device Utilizing Magnetic and Paper Tape Recording"	A	Partridge, Anderson, Geldmacher, Dunkin	11/1	10	10	121	XVIII	4	A	5
865-Synopses of Highway Research Board Papers	---	Staff	11/1	18	0	121	XVIII	4	A	14
866-File Index	---	Michael	11/1	32	0	121	XVIII	4	A	32
867-Plan of Study "Skidding Resistance of Bituminous Surfaces"	53D	Shupe	12/5	5	1	121	XVIII	4	A	67
868-Proposed Budget for the Period January 1 - March 31, 1957	---	Michael	12/5	6	0	121	XVIII	4	A	72
869-Plan of Study "A Study of the Fatigue Properties of Air Entrained Concrete"	58B	Antrim	12/5	14	0	121	XVIII	4	A	78
870-Final Report "Subgrade Support Characteristics - Experimental and Theoretical" (1956 JHRP Report No. 38)	A	Geldmacher, Anderson, Dunkin, Partridge, Harr, Wood, Lear	12/5	268	108	121	XVIII	4	A	92

Report and No.	Proj. C-36	Author	Date	Pages	Figs.	Bk.	Vol.	No.	Pt.	Pg.
871-Progress Report No. 5 "State Highway Needs in Indiana" (1956 JHRP Report No. 39)	54T	Branham, Covault, Michael	12/5	57	43	121	XVIII	4	A	360
872-Progress Report "Results of Tests on Bituminous Cores Taken from U. S. 31 Test Road"	55F	Sutton, Goetz	12/5	25	3	121	XVIII	4	A	418
873-Plan of Study "The Preliminary Location of a Proposed Highway by Photogrammetric Surveys"	32M	Bailey	12/5	10	0	121	XVIII	4	A	443
874-Progress Report No. 1 "Experimental Dampproofing of Two Bridges"	37Z	Dolch	1/24	8	5	122	XIX	1	A	3
875-Plan of Study "Design and Evaluation of Traffic Access to a Shopping Center"	54Y	Kask	1/24	8	0	122	XIX	1	A	11
876-Plan of Study "Intersection Lane Controls on Urban Thoroughfares"	17K	MacNaughton	1/24	13	2	122	XIX	1	A	19
877-Plan of Study "Correlation of Accident Rates and Roadway Factors"	59C	Woo	1/24	8	0	122	XIX	1	A	32
878-Plan of Study "A Supplementary Legend at Four-Way Stop Intersections"	17Q	Cooper	1/24	7	0	122	XIX	1	A	40
879-Final Report "Power Augers and Earth Resistivity Units as Supplements to Drilling Machines" (1957 JHRP Report No. 1)	36E	Shurig	1/24	154	40	122	XIX	1	A	47

Report and No.	Proj. C-36	Author	Date	Pages	Figs.	Bk.	Vol.	No.	Pt.	Pg.
880-Technical Paper "The Strength of Bituminous Mixtures and Their Behavior Under Repeated Loads, Part II" (1957 JHRP Report No. 2)	6J	Wood, Goetz	1/24	45	14	122	XIX	1	A	201
881-Final Report "A Study of the Air-Void Characteristics of Hardened Concrete" (1957 JHRP Report No. 3)	37Q	Feare	1/24	114	15	122	XIX	1	A	246
882-Final Report "Creep and Shrinkage Strains in Prestressed Concrete Using Two Typical Indiana Aggregates" (1957 JHRP Report No. 4)	58A	Midgaard	1/24	108	52	122	XIX	1	A	360
883-Proposed Budget for the Period April 1 - June 30, 1957	---	Michael	2/21	2	0	123	XIX	1	B	2
884-Technical Paper "Pumping of Highway and Airfield Pavements" (1957 JHRP Report No. 5)	45F	Yoder	2/21	87	27	123	XIX	1	B	4
885-Technical Paper "A Study of the Interactions of Selected Combinations of Subgrade and Base Course Subjected to Repeated Loads" (1957 JHRP Report No. 6)	45F	Havers, Yoder	2/21	83	16	123	XIX	1	B	91
886-Final Report "The Load Carrying Characteristics of a Bituminous Concrete Resurfacing Mixture" (1957 JHRP Report No. 7)	6F	McLaughlin	2/21	166	28	123	XIX	1	B	174

Report and No.	Proj. C-36	Author	Date	Pages	Figs.	Bk.	Vol.	No.	Pt.	Pg.
887-Informational Report "A Literature Survey on Soil Stabilization with Lime Fly-Ash Admixtures" (1957 JHRP Report No. 8)	---	Kocataskin	2/21	24	0	123	XIX	1	B	340
888-Technical Paper "Considerations on Equipment, Methods, and Standards of Accuracy Applicable to Aerial Surveys for Different Purposes" (1957 JHRP Report No. 9)	---	Miles	4/4	23	0	124	XIX	2	A	2
889-Technical Paper "Subgrade Support Characteristics" (1957 JHRP Report No. 10)	A	Geldmacher, Anderson, Dunkin, Partridge, Wood, Harr	4/4	44	19	124	XIX	2	A	25
890-Plan of Study "Environmental Warping of Concrete Highway Pavements"	A	Harr	4/4	44	9	124	XIX	2	A	25
891-Plan of Study "Study of Runoff from Small Drainage Areas for Highway Drainage Design in the State of Indiana"	62A	Delleur	4/4	8	0	124	XIX	2	A	113
892-Plan of Study "The Effect of Pavement Type and Edge Markings on Lateral Placement"	17R	Weckesser	4/4	12	0	124	XIX	2	A	121
893-Final Report "Selection and Retention of Civil Engineer Employees" (1957 JHRP Report No. 11)	54X	Branham	4/4	93	3	124	XIX	2	A	133

Report and No.	Proj. C-36	Author	Date	Pages	Figs.	Bk.	Vol.	No.	Pt.	Pg.
894-Synopsis of Papers for Purdue Road School	——	Staff	4/4	8	0	124	XIX	2	A	226
895-Progress Report No. 61 "Traffic Speeds" (1957 JHRP Report No. 12)	10C	MacNaughton	5/9	22	8	124	XIX	2	A	245
896-Proposed Budget for the Period July 1 - September 30, 1957	——	Michael	6/12	6	0	125	XIX	2	B	3
897-Final Report "The Effect of Basic Course Gradation on the Results of Laboratory Pumping Tests" (1957 JHRP Report No. 13)	45F	Chamberlin	6/12	126	34	125	XIX	2	B	9
898-Final Report "Triaxial Testing of Bituminous Mixtures at High Confining Pressures" (1957 JHRP Report No. 14)	6K	Oppenlander	6/12	149	41	125	XIX	2	B	135
899-Technical Paper "Highway Research and the Expanded Highway Construction Program" (1957 JHRP Report No. 15)	——	Woods	6/12	19	0	125	XIX	2	B	284
900-Technical Paper "Highway Highlights of 1956 and the Challenge Ahead" (1957 JHRP Report No. 16)	——	Branham	6/12	29	0	125	XIX	2	B	303
901-Technical Paper "Performance Data for Some Bituminous Concrete Overlays in Indiana" (1957 JHRP Report No. 18)	31C	Goetz, McLaughlin	6/12	31	11	125	XIX	2	B	332

Report and No.	Proj. C-36	Author	Date	Pages	Figs.	Bk.	Vol.	No.	Pt.	Pg.
902-Informational Report "Results of Tests on Mortars and Concretes Containing a Mechanically Precipitated Fly Ash" (1957 JHRP Report No. 19)	----	Kocataskin, McLaughlin	6/12	44	8	125	XIX	2	B	363
903-Bibliography "Supplement No. 2 Bibliography on Mineral Aggregates 1953 - 1956"	----	McLaughlin	6/12	30	0	125	XIX	2	B	407
904-Plan of Study "Hydraulics of River Flow Under Arch Bridges"	62B	Delleur	6/12	4	0	125	XIX	2	B	437

SUMMARY TABULATION OF RESEARCH PROJECTS

Status as of June 30, 1957

KEY TO STATUS NUMBERS

Key Number	
1	Complete--unpublished.
2	Complete--published (including completed theses).
3	Incomplete--inactive.
4	Complete--publication in progress.
5	Active--incomplete.
6	Being started.
7	Planned.

* Resigned

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
1	6-3	Jackson*	2	Test Road No. 1, old series
2	6-4	Jackson*	2	Test Road No. 1, new series
3	6-5	Jackson*	2	Test Road 2
4	2-3			Surface Treatment
	2-3-1	Shelburne*	2	A--1935 & Older Construction
	2-3-2	Shelburne*	2	B--1936 Construction
	2-3-3	Shelburne*	2	C--1937 Construction
5	6-6			Laboratory Soil Studies
	6-6-1	Graves*	1	A--Durability
	6-6-2	Winn*	2	B--Frost Action
	6-6-3	Kay*	2	C--Permeability
	6-6-4	Mayo*	2	D--Compression
6	2-4			Bituminous Mixtures
	2-4-1	Graves*	3	A--Pugmill
	2-4-2	Graves*	1	B--Patch Materials
	2-4-3	Graves*	3	C--Unconfined Compression Tests
	2-4-4	Layman*	2	D--Unconfined Compression & Squeeze Tests
	2-4-5	Chen*	2	E--Stability
	2-4-6	McLaughlin	2	F--Resurface Mixtures
	2-4-7	Herrin*	2	G--Particle Shape
	2-4-8	Havers* & Dusenbury*	2	H--Rubber Asphalt
	2-4-9	Osili*	2	I--Seal Coats

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
	2-4-10	Wood	2	J--Str. & Deform. Charac.
	2-4-11	Oppenlander	2	K--Triaxial Testing at High Pressure
	2-4-12	Zagarra*	2	L--Aggregate Bituman Mixtures
	2-4-13	Goetz	2	M--Strength by Marshall Test
7	2-5			Rock Asphalt
	2-5-1	Goetz, Tyler*	2	A--Exploratory Study
8	2-6			Bituminous Adhesion
	2-6-1	Goetz	2	A--Untreated
	2-6-2	Tyler*	3	B--Treated
	2-6-3	Andersland*	2	C--Sonic Test Evaluation
9	5-3			Aggregate Degradation
	5-3-1	Shelburne*	2	A--Under Road Rollers
10	8-3			Traffic Speeds
	8-3-1	Lawshe*	2	A--Bibliography
	8-3-2	Branham	2	B--Equipment Development
	8-3-3	Staff	5	C--Periodic Speed Studies
	8-3-4	Staff	5	D--Truck Speed - Weight Study
11	9-1			Climatic Data
	9-1-1	Staff	1	A--Winter Weather 1935-51
12	2-7			Test Road No. 3
	2-7-1	Goetz, Shelburne*	2	A--Resurvey
	2-7-2	Chang*	2	B--Sample Tests
13	6-7	Belcher*	2	Test Rd. Sur. Treat.
14	6-8			Triaxial Tests
	6-8-1	Yoder	1	A--U. S. 41 Test Road
	6-8-2	Yoder, Wood, Hampton	5	B--Effect of Rate of Loading
	6-8-3	Cregg*	2	C--Soil and Soil Mixtures
15	6-9			Drainage
	6-9-1	MaAlpin*	2	A--Small Models
	6-9-2	McClelland*	2	B--Large Models
	6-9-3	Ku*	2	C--Capillarity
	6-9-4	Hittle*	3	D--Capillary Potential
	6-9-5	Robertson*	2	E--Permeability
	6-9-6		3	F--Agg. Grad. for Drains
	6-9-7	Slessor*	1	G--Soil-Vapor Press.
	6-9-8	Yeh	2	H--Hydrology
	6-9-9	Kashef*	2	L--Numerical Solution to Flow Problems

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
16	6-10			Field Soil Temp. and Moisture
	6-10-1	Yoder & Lowrie*	2	A--Field Installations
	6-10-2	Lennertz* & Lovell	3	B--Soil Temp. Gages
	6-10-3	Lovell	3	C--Soil Mois. Meas. Dev.
	6-10-4	Lovell	1	D--Freezing Index Maps
17	8-4			Traffic Engineering Research
	8-4-1	Green	3	A--Signs
	8-4-2	Wilson*	2	B--Intersections
	8-4-3	Green	3	C--Prt. Usage
	8-4-4	O'Mara*	2	D--Accidents
	8-4-5	Quimby*	2	E--Effect of Narrow Bridges
	8-4-6	Overmyer*	2	F--Width, Pavement
	8-4-7	Baerwald*	2	G--Public Opinion Poll
	8-4-8	Lang*	2	H--Shoulders Influence
	8-4-9	Barkley*	2	I--Bibliography
	8-4-10	Baerwald*	3	J--Effect of Median Strip
	8-4-11	MacNaughton	5	K--Turn Lane Controls
	8-4-12	Rosenfield*	2	L--Lateral Placement of Vehicles
	8-4-13	Baerwald*	1	M--Drive-In Theatre Traffic
	8-4-14	Michael	3	N--Intersectional Illumination
	8-4-15	Jackman*	2	O--Driver Obedience to Signs
	8-4-16	Bazz*	2	P--Scramble System
	8-4-17	Cooper	5	Q--4-Way Stop
	8-4-18	Weckesser	5	R--Edge Striping Effect on Lateral Placement
18	5-4			Chert in Aggregate
	5-4-1	Sweet*	2	A--In Indiana
19	5-5			Concrete General
	5-5-1	Jones*	2	A--Phys. Characteristics
	5-5-2	Robertson*	1	B--Cores, U. S. No. 40
	5-5-3	Jones*	1	C--Fatigue
20	4-3			Salt Migration
	4-3-1	Slesser*	2	A--Laboratory
	4-3-2	Frost*	1	B--Route 30 Heave
	4-3-3	Frost*	1	C--Buffalo-Laporte
21	2-8			Local Aggregates
	2-8-1	Metcalf*	2	A--Sandstone
	2-8-2	Rico*	2	B--Sands
22	2-9			Bituminous Emulsions
	2-9-1	Tyler*	2	A--Bituminous Emulsions

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
23	5-6			Concrete Sealing
	5-6-1	Green	3	A--Linseed Oil
	5-6-2	Green	3	B--Field Studies
	5-6-3	Green, Shelburne*	3	C--U. S. 20 Study
24	2-10			Bituminous Structure
	2-10-1	Bonewitz*	2	A--Microscopic Technique
25	9-2			Dynamic Modulus
	9-2-1	Bass*	2	A--Bit.-Agg. Mix.
	9-2-2	Whitehurst*	2	B--Time of Set
	9-2-3	Yong*	2	C--Sonic vs. Mech. Test of Bitum. Mix.
	9-2-4	Whitehurst*	2	D--Soil-Cement and Soil-Lime
	9-2-5	Whitehurst*	2	E--Field Use
26	4-4			Paints
	4-4-1	Goetz	2	A--Traffic Paints
	4-4-2	Goetz	1	B--Blackout Paints
	4-4-3	Goetz	5	C--Laboratory & Field
	4-4-4	Goetz	3	D--Bridge Paint
	4-4-5	Blackburn*, Dolch	2	E--Waterproofing
	4-4-6	Goetz	3	F--Prison Paints
27	6-11	Shelburne*	1	Test Road No. 4
28	9-3			Photoelasticity
	9-3-1	Woodsmall*	2	A--Subg. Stress
	9-3-2	Baker*	2	B--Calculations
	9-3-3	Hittle*	1	C--Dowel Bars
	9-3-4	Hittle*	1	D--Conc. Arch
29	1-3			Aerial Strip Maps
	1-3-1	Hobbs*	3	A--Highway Locations
	1-3-2	Hittle*	2	B--Use of Strip Maps
	1-3-3	Miles	2	C--Strip Map Location
30	9-4			Geology
	9-4-1	Woods, Yoder & Johnstone*	2	A--Preglacial Marietta River
31	2-11			Bituminous Performance
	2-11-1	Shelburne*	1	A--Route 26
	2-11-2	Shelburne*	1	B--Route 17
	2-11-3	McLaughlin, Goetz	5	C--Bituminous Concrete Stability
	2-11-4	Shelburne*	1	D--Spring Breakup 1943
	2-11-5	Green	1	E--Spring Breakup 1945
	2-11-6	Goetz	1	F--Spring Breakup 1951

Project C-35	File No.	Assigned to	Status (See Key)	Title of Project
32	1-4			Airphoto Interpretation
	1-4-1	Belcher*	2	A--Grammar Materials
	1-4-2	Frost*	3	B--Rough Topography
	1-4-3	Parvis	5	C--Airphoto Bibliography
	1-4-4	Frost*	1	D--Use in Location
	1-4-5	Parvis	2	E--Use in Drainage
	1-4-6	Monhano*	3	F--Indiana Soils-Northern
	1-4-7	Frost*	3	G--Indiana Soils-Southern
	1-4-8	Frost*	1	H--U. S. 40, Terre Haute
	1-4-9	Mollard*	1	I--Valparaiso Moraine
	1-4-10	Nishimura*	2	J--Erie Moraines
	1-4-11	Howe*	2	K--Ground Water
	1-4-12	Miles	5	L--Topographic Mapping
	1-4-13	Bailey	5	M--Mapping for Preliminary Location
33	6-12	McAlpin* Belcher*	1	Test Road No. 5
34	6-13	Belcher*	1	Test Road No. 6
35	5-7			Conc. Performance
	5-7-1	Shelburne*	1	A--Route 67
	5-7-2	Tung*	1	B--Route 29
	5-7-3	Shelburne*	1	C--Route 6
	5-7-4	Shelburne*	1	D--Route 30
	5-7-5	Shelburne*	1	E--Roughness
	5-7-6	Camp*	1	F--U. S. No. 50
36	6-14			Indiana Soil Problems
	6-14-1		1	A--Equipment
	6-14-2	Lennertz*	2	B--Geophysical Testing
	6-14-3	Larew*	2	C--Landslides
	6-14-4	Woods	2	D--Soil Surveys
	6-14-5	Shunig	2	E--Subsurface Exploration
	6-14-6	Moore*	2	F--Airphoto Evaluation
37	5-8			Conc. Durability
	5-8-1	Shelburne*	3	A--Curing
	5-8-2	Sweet*, Woods	2	B--Base Courses
	5-8-3	Sowa*	3	C--Aggregate Absorption
	5-8-4	Lewis*, Sweet*	2	D--Sonic-Lab.
	5-8-5	Lewis*, Sweet*	2	E--Sonic Field
	5-8-6	Glover*, Lu*	3	F--Coef. Expansion
	5-8-7	Bugg*	2	G--Air Entrn. Admixtures
	5-8-8	Blackburn*	3	H--Disintegration Bibliography
	5-8-9	Pendley*	2	I--Restraint Effects
	5-8-10	Lu*	2	J--Therm. Shock
	5-8-11	Fears*	2	K--Pore Charac.

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
	5-8-12	Higg*, McLaughlin	5	L--Fine Aggregate
	5-8-13	Blackburn*	2	M--Agg. Dur. in Air-Entr. Conc.
	5-8-14	Barkley*	3	N--Concr. Admix.
	5-8-15	Batcholder*	2	O--Strength and Dynamic Properties
	5-8-16	Ventors*, Lewis*, McLaughlin	5	P--Gravel, Non-durable Constituents
	5-8-17	Batcholder*, Fears*	2	Q--Air Content, Hardened Concrete
	5-8-18	Lewis*, Whitehurst* McLaughlin	2	R--Bridge Concrete, Deterioration
	5-8-19	Lewis*, Irick* Blackburn*	2	S--Variability of Durability Tests
	5-8-20	Walker*	2	T--Gravel-Stone Mix.
	5-8-21	McLaughlin	5	U--HRB Cooperative Study
	5-8-22	McLaughlin	3	V--Dur. Pre-Stressed Conc.
	5-8-23	McLaughlin	5	W--Air-Entr. Conc. Pave. Survey
	5-8-24	McLaughlin	5	X--Freeze Thaw Tests
	5-8-25			Y--
	5-8-26	Dolch	5	Z--Dampproofing Treatment of Bridges
38	6-15			Soil Mapping
	6-15-1	Frosh*, Hittle*	2	A--Field and Lab.
	6-15-2	Frosh*	1	B--Route 20
	6-15-3	Frosh*	1	C--U. S. No. 31
39	7-3			Highway Loading
	7-3-1	Woods	2	A--Loading and Design Trends
40	6-16	Belcher*	1	Test Road 7
41	4-5			Plastics
	4-5-1	Yehalem*	2	A--Durability
	4-5-2	Lewis*	2	B--Strength
	4-5-3	Slate*	3	C--New Plastic & Sign
	4-5-4	Slate*	2	D--Centerline Markings
42	5-9			Aggregate Survey
	5-9-1	Swee*	2	A--Significance of Tests
	5-9-2	Woods	2	B--Origin & Destr.
	5-9-3	Fear*	2	C--Biblio. Aggreg.
	5-9-4	Lew*, McLaughlin	5	D--Specifications
	5-9-5	Lewis*, McLaughlin, Schuster	5	E--Indirect Scores

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
43	6-17			Pedological Soils
	6-17-1		3	A--St. Dens. Proctor
	6-17-2	Hittle*	3	B--Typ. Proctor Curves
44	5-10			Concrete Pumping
	5-10-1	Green	2	A--Field Surveys, 1943 and 1947
	5-10-2	Shelburne*, Green	2	B--Pvt. Jack
	5-10-3	Goetz, Green	2	C--Pumping Mixtures
	5-10-4	Goetz	3	D--Rig. Pvt. Salvage
	5-10-5	Lewis*	1	E--1951 Survey
	5-10-6	Lewis*	1	F--1954 Survey
45	6-18			Base Courses
	6-18-1	Yoder	2	A--Gran. Bases-Lab.
	6-18-2	Henderson*	2	B--U. S. 30 Bases
	6-18-3	Soon*	1	C--Temp. vs. Compaction
	6-18-4	Pollard*	3	D--Sand-Clay Distribution
	6-18-5	McCullough*	3	E--Ind. Sand-Clay Characteristics
	6-18-6	Yoder & Irick*	5	F--Rigid Pavement on Gran. Base
46	5-11			Conc. Pvt. Design
	5-11-1	Shelburne*	1	A--Deflection Stud.
	5-11-2	Sweet* & Woods	2	B--Blowup Survey--Perf.
	5-11-3	Hittle*	1	C--Thin Pvt. Surv.
	5-11-4	Lewis*	2	D--Resurf. Pvt. Surv.
	5-11-5	Lewis*	1	E--Joint Perf. Surv.
	5-11-6	Lewis*	1	F--Load Trans. Device
	5-11-7	Camp*	1	G--Conc. Exp.
	5-11-8	Melville*	1	H--Conc. Exp.
	5-11-9	Okamoto*	1	I--Freeze and Thaw
	5-11-10	Lewis*	1	J--Resurvey of Blowups
	5-11-11	Schnebeli*, Thoma & Lewis*	3	K--Strain Gauges
	5-11-12	Choksi*	2	L--Structural Design Bibliography
	5-11-13	Miller	5	M--Theoretical Strains & Stresses
47	4-6			Chemistry of Concrete
	4-6-1	Slate*	3	A--Gels
	4-6-2		3	B--Thin Sections
	4-6-3	Dolch	5	C--Solubility of Aggregates
	4-6-4	Slate*	2	D--Bibliography
	4-6-5	Fox*	2	E--Thermal
	4-6-6	Dolch	5	F--Aggr. Voids
	4-6-7	Dolch	5	G--Alkali Aggregate Reaction
48	9-5			Turf Studies
	9-5-1	Yoder	2	A--Early Studies

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
49				
50	6-19			Soil Stabilization
	6-19-1	Slesser*	1	A--Chemical
	6-19-2	Hills*	1	B--Molasses
	6-19-3	Johnson*, Dolch, & Yoder	1	C--Lime
	6-19-4	Sharma*	2	D--Bibliography
	6-19-5	Korman*	2	E--Soil Cal. Chloride Mix
	6-19-6	Yoder	1	F--Test Road Using DDAC
51	1-5			Soil, Drainage Mapping
	1-5-1	Parvis, Yeh, Magnusson	5	A--Drainage Maps
	1-5-2	Montano*, Yeh	5	B--Soils Maps
	1-5-3	Moultrop*	2	C--Loess Mapping
	1-5-4	McLerren*	2	D--SW Indiana Interbedded Shale
	1-5-5			E--
	1-5-6	Stylianopoulous*	2	F--SS and Shale of SW Indiana
	1-5-7	Robbins*	3	G--LS and Shale of SE Indiana
	1-5-8	Leighty*	2	H--Alluvial Terraces
	1-5-9	McGregor*	2	I--Agriculture Soil Map Use
	1-5-10	Yeh	5	J--State Drainage Map
	1-5-11	Montano*, Yeh	5	K--State Soils Map
	1-5-12	Dawson*	2	L--SS and Shale of SC Indiana
	1-5-13	Vantil*	2	M--LS of SC Indiana
	1-5-14	Stevens*	2	N--Illinoian Glacial Drift, SE Indiana
	1-5-15	Johnson*	2	O--Northern Indiana Sands
	1-5-16	Richert*	2	P--SS and Shale Areas
	1-5-17	Davis*	2	Q--NW Indiana Moraines
	1-5-18	Mintzer*	2	R--Illinoian Glacial Drift, SW Indiana
52	6-20			Pavement Design
	6-20-1	Ardaman* & Yoder	2	A--C.B.R. Tests
	6-20-2	Yoder	5	B--Flexible Pavement Design
53	9-6			Road Roughness & Skid
	9-6-1	Metcalf*, Thanos* Holloway*	2	A--Equipment, Roughness
	9-6-2	Grunau*, Baer-wald*	2	B--Skid Resistance Equipment
	9-6-3	McLaughlin	1	C--Skid Characteristics Bibliography
	9-6-4	Shupe	5	D--Bit. Mixture Skid Characteristics
	9-6-5	Grunau*, Michael, Shupe	5	E--Skid Resistance of U. S. 31 Test Rd.

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
	9-6-6	Rosenfield* Weckesser	5	F—Lateral Placement on U. S. 31 Test Rd.
	9-6-7	Grunau*, Michael	2	G—Skidding Characteristics, Indiana
	9-6-8	Grunau*, Shupe	5	H—Skid Tests on U. S. 421
	9-6-9	Holloway	2	I—Roughness Characteristics
54	3-3			Econ. & Admin.
	3-3-1	Michael	3	A—Wabash River Bridge
	3-3-2	May*	2	B—Lebanon Bypass
	3-3-3	Michael	2	C—Kokomo Bypass
	3-3-4	Baerwald*	2	D—Public Opinion Poll
	3-3-5	Branham, Baerwald*	2	E—County Road Marking
	3-3-6	Branham, Baerwald*	3	F—Cost Allocation
	3-3-7	May* & Yoder	3	G—Air Transportation
	3-3-8	May*	3	H—Laf. Trans. Study
	3-3-9	May*	2	I—Logansport Study
	3-3-10	Michael	2	J—Richmond Study
	3-3-11	Michael	3	K—Bloomington Study
	3-3-12	Bauer*	3	L—Logansport Parking
	3-3-13	Kell*	2	M—O-D Surv. Methods
	3-3-14	Stoner*, Petty, Woods & Branham	2	N—Co. Highway Admin.
	3-3-15	Miller*	2	O—Sampling Techniques
	3-3-16	Baerwald*	2	P—County Classification
	3-3-17	Michael & Edwards*	2	Q—Huntington Survey
	3-3-18	Baerwald*	2	R—Allen Co. Study
	3-3-19	Branham	2	S—Recruitment of Engineers
	3-3-20	Michael	5	T—State Highway Needs Study
	3-3-21	May*	2	U—Evaluation of Limited Access Highways
	3-3-22	Barr*	2	V—Urban Characteristics for O-D Surveys
	3-3-23	Cribbins	3	W—Northern Indiana Seaport
	3-3-24	Branham	5	X—Engineer Retention Study
	3-3-25	Kask	5	Y—W. Lafayette Shopping Center Study
55	2-12			Flex. Pavement Design
	2-12-1	Goetz	5	A—General
	2-12-2	Lowrie*	2	B—Design
	2-12-3	Metcalf*	3	C—Test Road, Churubusco
	2-12-4	Herrin*	3	D—Thickness Design

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
	2-12-5	McLaughlin	2	E--Bituminous Concrete
	2-12-6	Goetz	5	F--U. S. 31 Test Road Cores
56	7-4			Bridges
	7-4-1	McCammon*	3	A--Dynamic Forces
	7-4-2	Hayes, Sbarounis*	2	B--Vibration
	7-4-3		3	C--Soil Pressure, U-Type Bridge
	7-4-4			D--
	7-4-5	Wyly*	3	E--Design of Washers for High Tensile Bolts
57	5-12			Cement
	5-12-1	Blackburn*	1	A--Slag Cement
58	5-13			Prestressed Concrete
	5-13-1	Midgaard*	2	A--Creep & Shrinkage
	5-13-2	Nordby*, Antrim	5	B--Endurance, Fatigue
59	8-5			Traffic Safety
	8-5-1	Michael	5	A--Crash Injury
	8-5-2	Michael	5	B--Safety Belts
	8-5-3	Woo	5	C--Accident Rate vs. Design Features
60	3-4			Highway Cost Studies
	3-4-1	Belcher*	1	A--Mass Diagram
	3-4-2	Mylroie	5	B--Receipts and Disbursements, N. C. States
61	5-14			Concrete Characteristics
	5-14-1	McLaughlin	6	A--Temp. Effect on Air Bubble Distribution
62	9-8			Hydraulics
	9-8-1	Delleur	6	A--Runoff from Small Drainage Areas
	9-8-2	Delleur	6	B--Hydraulics of Arch Bridges
C-36A	9-7	Geldmacher, Anderson, Dunkin, Wood, Harr	2	Highway Deflection

LISTING OF CODE NUMBERS FOR PROJECTS OTHER THAN FUND 5112
AS SHOWN IN ATTACHED LISTING OF EXTRA LABOR EMPLOYEES
OF THE JOINT HIGHWAY RESEARCH PROJECT

Code Number	Fund Number	Fund Name
1		Work on contracts
1a	5683	Fed. Res. CAA #2
1b	5678	Fed. Res. CAA #1
2	5661	Cal. Chloride Association
3	5722	Fed. Res. Permafrost Investigation
4	5761	PRF Fellowship No. 371A
5	5777	Lime-Soil Research
6	5796	AAR Concrete Research
7	5805	Fed. Res. Permafrost Investigation #2
8	5806	Fed. Res. Trafficability Study
9	5807	Fed. Res. Site Selection
10	5808	Fed. Res. Aerial Reconnaissance
11	5822	PRF Fellowship No. 578
12	5833	Waterways Experiment Station Research
13	5842	Calcium Chloride Soils Research
14	5843	Dow Chemical Concrete Research
15	5866	Soil Strength Characteristics
16	5869	Fed. Res. Prediction Trafficability
17	5870	Fed. Res. Airphoto Trafficability
18	5878	PRF Fellowship No. 796
19	5883	Permafrost Report Publication
20	5893	American Steel Dredge Research #2
21	4414	Conference 4414 (Technical Extension Div.) Short Course—Airphotos
22	5411	Fees — EES

23		State Highway Commission payrolls for the production of drainage and soil maps.
24		State Highway Commission payrolls covering the transportation surveys.
25	5411	Traffic Engineering Services
26	5112A	Indiana State Highway 5112A
27	5926	PRF #927
28	5934	PRF #953
29	5935	PRF #954
30	5936	Fed. Res. Soil Freezing Characteristics
31	5939	Yuma Test Branch Terrain Study
32	5940	Engineering Physiography of North America
33	5955	Bakelite Water Barrier
34	5201	International Salt Company

EXTRA LABOR EMPLOYEES

Supplement No. 3*

Termination Between July 1, 1956 and June 30, 1957

Employee	Work on Other Projects	Employed	Resigned
Allison, Robert		10-1-56	5-31-57
Armbruster, Jerome		8-1-56	2-15-57
Bakker, Jaap		7-1-56	8-15-56
Berger, Hakon		7-16-56	8-15-56
Bradley, E. R.	27, 33	1-1-56	5-31-57
Brand, William D.		9-16-56	9-30-56
Brugos, David P.		3-16-57	5-31-57
Brunner, Wayne		11-1-56	1-31-57
Burgard, W. C.		6-1-55	11-30-56
Butzer, Neil		10-1-56	1-31-57
Chen, Charles S.		10-1-56	10-15-56
Colter, Richard E.		8-16-56	2-15-57
Dillabar, Roger		4-1-57	4-30-57
Drake, Maurice D.		6-1-57	6-15-57
Egilmez, Ali	17	6-1-57	6-15-57
Enz, Edward R.	33	12-1-56	5-15-57
Ewing, William C.		4-1-57	5-31-57
Federle, Paul E.		10-1-56	3-31-57
Gardner, Carolyn		7-1-56	7-31-56
Geraldo, Robert E.		9-16-56	11-15-56
Goff, Edward		3-16-57	4-30-57
Hafsted, Kjell		11-15-56	11-30-56
Henning, Robert J.		7-16-54	5-31-57
Horine, Donald R.		11-1-56	12-31-56
Humphrey, Lee		4-1-57	6-15-57
Irwin, John W.		6-1-57	6-15-57
Jansen, Robert E.		3-16-57	5-31-57
Johnson, Robert L.		5-1-57	5-31-57
Jordan, Edwin W.		1-1-57	5-15-57
Kenyon, John		9-16-54	9-15-56
Koning, Martha	27	12-1-56	12-15-56
Kravet, Robert		9-16-56	12-15-56
Kalarad, Steiner		8-1-56	9-15-56

Employee	Work on Other Projects	Employed	Resigned
Lee, Frank T.	27, 17, 33	7-1-56	5-31-57
Lee, Robert H.	33	7-16-55	1-31-57
Matz, Don L.		4-1-57	5-31-57
McKinney, G. A.	17	5-1-57	
Messenger, F. H.	27, 17, 33	7-1-56	10-31-56
Miller, Ken M.		11-1-56	12-31-56
Mottern, J. E.		4-1-57	4-15-57
Myint, Maung Aye		8-16-57	9-30-56
Nichols, Fred L.		4-1-57	5-31-57
Park, Roger		6-1-56	11-15-56
Pliego, Jose		8-1-56	9-15-56
Purdue, Ronald E.		2-16-55	12-31-56
Reddy, Udumala	17	6-1-57	6-30-57
Reed, Merwyn O.	17	11-16-53	8-31-56
Rinker, Betty		5-16-55	8-31-56
Risk, David M.		4-1-57	5-31-57
Ross, David		8-1-56	9-15-56
Schnabel, Ted	17	2-1-57	4-15-57
Schory, G. P.		2-1-56	9-15-56
Shepherd, Violet	17	11-15-55	6-15-56
Shupe, John W.		8-1-56	1-15-57
Smith, Larry D.		7-1-56	7-16-56
Snouwaert, Carolyn		7-16-56	8-15-56
Southerland, James		2-15-57	4-30-57
Stark, P. G.	17	2-1-56	5-31-57
Stein, Arlan D.		4-1-57	5-31-57
Sutton, James		9-1-55	5-31-57
Thorud, Ingolf		5-1-56	4-15-57
Triece, Samuel		8-1-55	1-15-57
Udahl, Svein Tore		8-1-56	4-15-57
Vansickle, John G.	27, 33	11-1-56	5-31-57
Wheeler, R. E.	17	2-15-57	6-15-57
Williams, Edwin		3-1-57	3-15-57
Wong, Bill S. C.		2-1-57	2-28-57
Woo, John C. H.		6-1-56	9-15-56
Wood, Donald H.		4-1-54	5-31-57
Zink, Gloria		12-16-56	1-15-57

* For listing of all terminations prior to July 1, 1954, see the "Annual Report of the Associate Director for 1953-54". For terminations after July 1, 1954 see the Annual Reports of the Assistant Director for 1954-1955 and 1955-1956.

Still Employed on July 1, 1957

Employee	Work on Other Projects	Employed
Dean, P. B.	27	1-1-56
Denny, Murle E.	17	9-16-56
Dogue, Ricardo		2-15-57
Haas, John N.		6-1-57
Knox, Beverly	17, 27, 33	6-1-57
Kraft, Carl J.		2-15-57
Mendenhall, Gerald	17	6-1-57
Neufer, Edward L.		6-1-57
Peeler, Don		2-1-55
Pierick, Jerry		6-1-57
Roath, James A.		6-1-57
Stewart, Morris R.		9-16-56
Witek, L. E.		3-1-55